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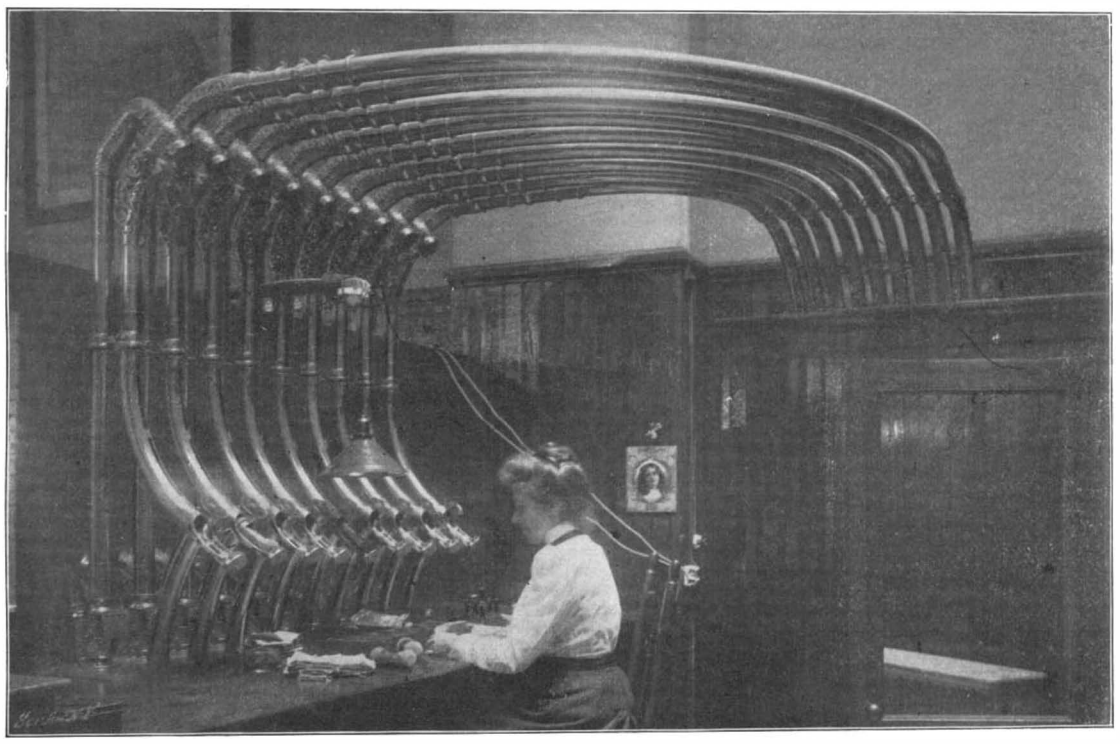
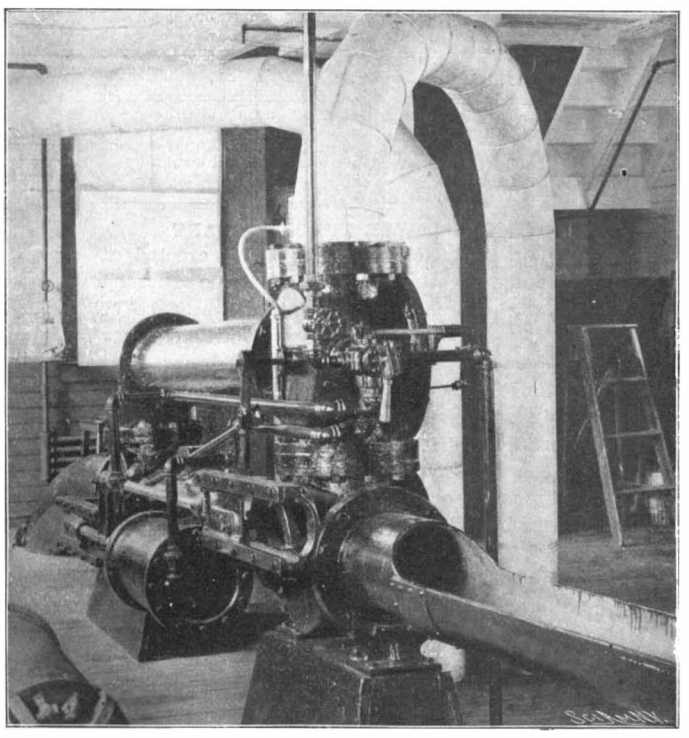
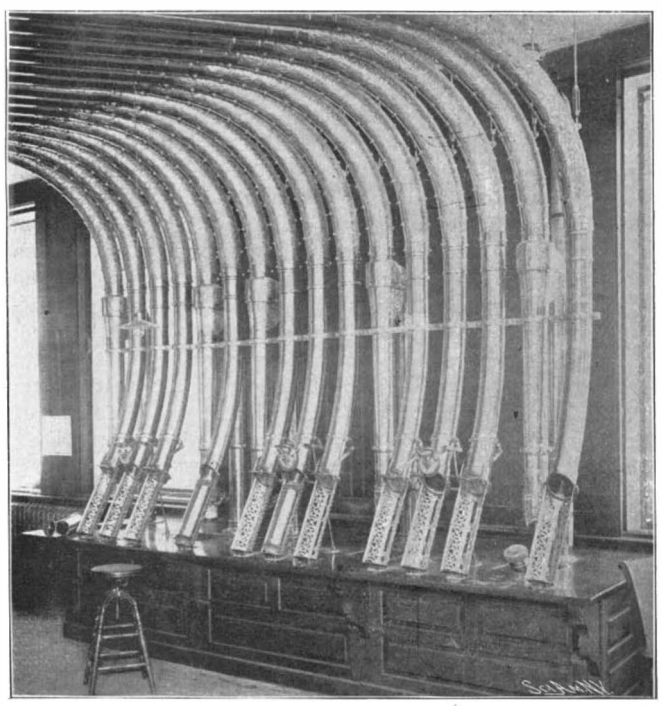


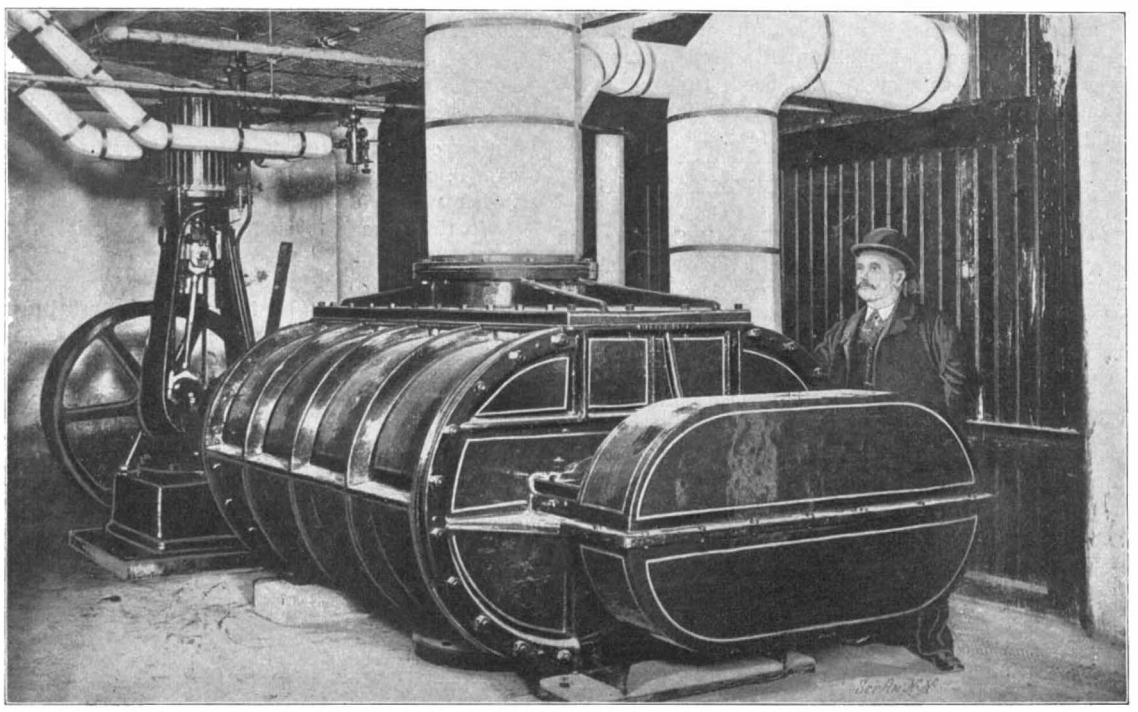
Pneumatic Tubes Controlled by One Operator



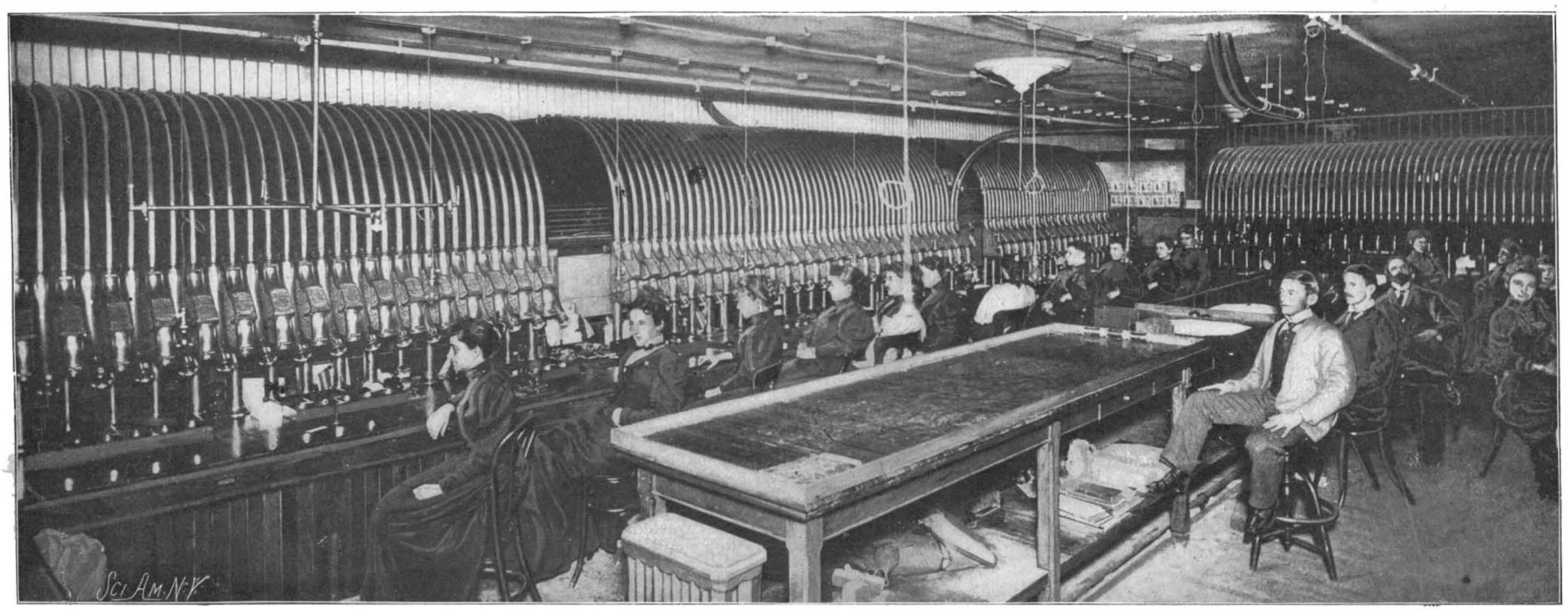
Engine and Section of Conduit of the Boston Pneumatic Package Service.



Sending Tubes Connecting With Sales Department. Terminals in Cashier's Office.



Power Plant Showing Engine, Blowers and Main Conduits.



Cashier's Office in a Large Department Store Showing Pneumatic Receivers

THE PNEUMATIC TUBE SYSTEM OF A MODERN DEPARTMENT STORE.—[See page 206].

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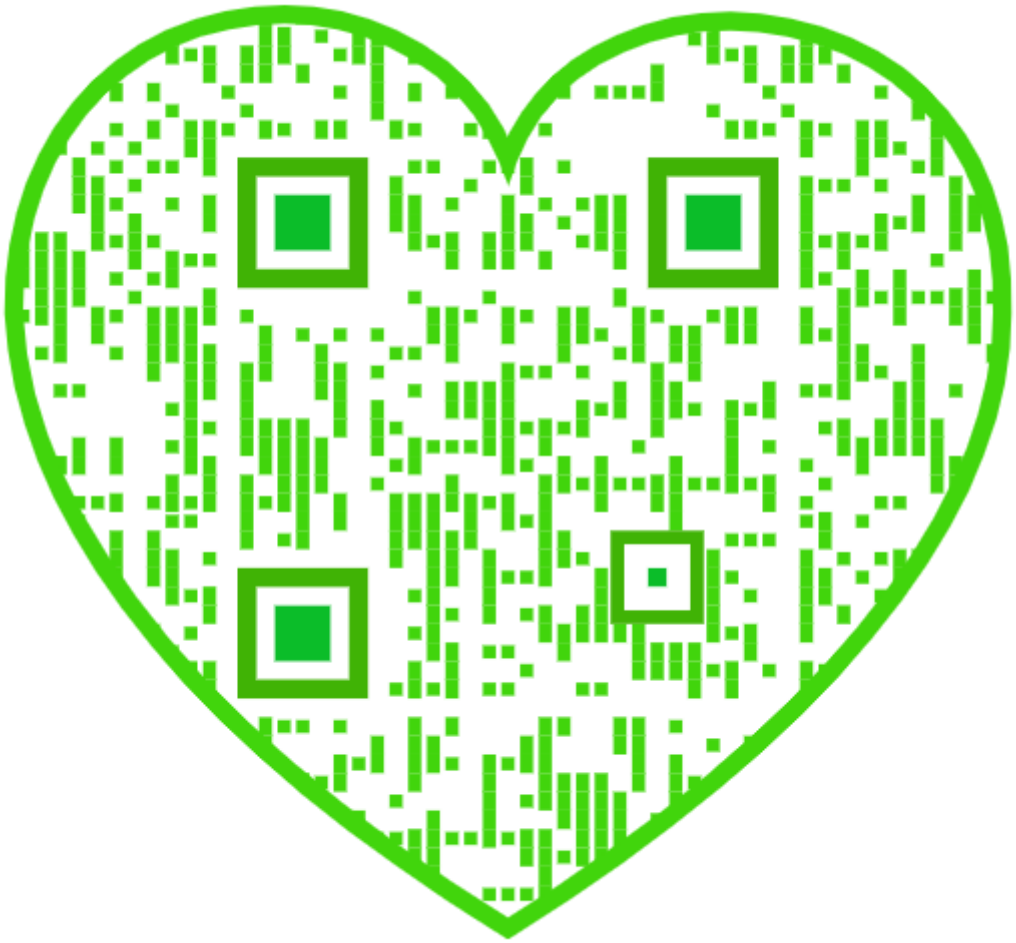

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NEW YORK, SATURDAY, MARCH 21, 1903.

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

A 75,000 HORSE POWER TURBINE PLANT.

The great power station which is being erected at Chelsea, London, for the operation of the District Railway system, possesses special interest because of the fact that it will be the first large electrical power station to be operated entirely by steam turbines. The plant will consist of ten turbines, each of 7,500 horse power, with an overload capacity of 50 per cent above the normal rating. The turbines, which are being supplied by the British Westinghouse Company, will be of the Parsons type with Westinghouse modifications. Each turbine will be direct-connected to a three-phase generator of 5,500 kilowatts running at a speed of 1,000 revolutions per minute. There will be only four field-magnet poles, and current will be produced at 11,000 volts potential. The dynamos and the turbines are being built, part of them at the works of the American Westinghouse Company at Pittsburg, and part at the new works of the British company at Manchester. As a result of the high speed of revolution, and the consequent small number of field magnet poles required, the dynamos will be only about 9 feet in diameter; whereas, if reciprocating engines, of the type used at the Metropolitan Elevated Company's power station in this city, were used, running at 75 revolutions per minute, the diameter of the generators would have to be not less than 32 feet.

PERMANENCE OF STEEL FRAMEWORK IN TALL BUILDINGS.

The construction of the Rapid Transit Subway has necessitated the pulling down of a twelve-story skeleton steel building at the corner of Broadway and Forty-second Street, which was erected early in 1899. Its removal has given an opportunity to determine how far the methods adopted for the prevention of rusting or oxidation of the steel of these buildings are successful. Of course, the period of time during which the steel has been incased, three years, is very limited; but it is sufficiently lengthy to afford at least some indications of what may take place during the lapse of centuries. At the time of erection the steel work was given two coats of paint composed of carbon and linseed oil. The columns and girders were incased either in rectangular shells of brick, or with red brick and terra cotta; if with the latter, the spaces between the inclosing material and the steel work were filled in with brick and cement mortar. After the recent removal of the brickwork and terra cotta, the steel was found to be in first-class condition and showed no signs of decay. In the few spots where there was a slight evidence of oxidation, the rust had been on the columns, apparently, at the time they were put up, or it was due to some abrasion of the protecting coat of paint. It is interesting to note that the outside columns supporting the outer walls of the building were found to be in just as good shape as those in the interior of the building. Although, as we have said, the period of test was a brief one, it is considered by architects to have been long enough to establish the thoroughly reliable nature of the standard methods of protection adopted in this form of building.

THE CHANGES IN THE CROTON DAM.

It was to be expected that when the present Chief Engineer of the Aqueduct Commission proposed to make a radical change in the plans of the partly completed Croton Dam, his action would provoke more or less criticism. The vast importance of this great work, the standing and acknowledged professional ability of the former engineer, Mr. Fteley, who is responsible for the original design of the dam, and the fact that the radical changes proposed would involve the tearing down of a considerable portion of the completed structure, combined to produce a feeling of astonishment that any such fundamental reconstruction should now be proposed. However, after giving careful consideration to the reasons assigned for the proposed changes, and making a personal investigation at the dam, the SCIENTIFIC AMERICAN came to the conclusion that so far from having needlessly delayed the completion of the Croton Dam, Mr. Hill, the chief engineer, has not only added greatly to the stability and appearance of the structure, but has prevented the incorporation of a feature in the design which, in all likelihood, would have brought about the ultimate collapse of the dam. To say the least, it was a delicate task to propose a change which would look like an indirect censure of the plans of a distinguished predecessor; and it was a daring task when such changes were certain to provoke a storm of angry opposition from the citizens, who had already grown weary of the prolonged delay in the completion of this much-needed work. While we question altogether the judgment, we can fully understand that it was the best of motives which prompted the Merchants' Association of New York to criticise both the present Chief Engineer of the Aqueduct Commissioners and the Commissioners themselves for the delay of the dam. At the same time it is distinctly fortunate that the present Mayor of New York was able to take a clear grasp of the situation, and so far from removing the Commissioners, as the Merchants' Association demanded, did not hesitate to indorse their work, especially as concerns the proposed changes.

Mr. Fteley, who designed the original structure, substituted an earth dam for a solid masonry dam on the southern end of the structure, for reasons of economy. That he himself was at one time sensible to the risks which led his successor to condemn the earth dam, is shown by the following extract from a report on the great Quaker Bridge Dam, for which the present dam was afterward substituted, made by him as Consulting Engineer to the Aqueduct Commissioners, as far back as July 25, 1887, in which he says:

"An earth dam, with a core of masonry, was also considered. In such structures, the thrusts exerted by the earth against the center wall, during construction and at the different stages of the water surface, when filling or emptying the adjacent basin, are unknown or, at the best, very uncertain; if the wall became fractured under their action, or allowed the water, in places, to pass through, the leaks, under such a considerable and unusual pressure, would endanger the stability of the earth embankment. Moreover, the authorities agree that this kind of structure is not safe to adopt beyond a certain limit of height; and it was thought unwise to attempt an experiment, which owing to the importance of the interests involved, was not justified by the saving in expense which might have been effected by its adoption.

"In this case, where the welfare of New York is concerned, and where the consequences of a possible disaster, with 30,000,000,000 gallons of water behind the dam, may well be imagined, we must deal with certainties: we have before us many successful instances of masonry dams, although of less magnitude, and the proposed structure can be so proportioned and constructed in masonry as to stand effectually the great pressure to which it is to be subjected."

It was in practically the same terms that the present Chief Engineer of the Commission recommended that a revision of the Croton Dam plans be made, to the extent of substituting masonry for earth, and we think that the above quotation from a report of the original designer of the dam itself should silence forever all criticisms that might suggest that the change in the plans was made from any other motive than that of securing the most durable and perfect structure possible.

WARSHIP CONSTRUCTION IN PRIVATE AND GOVERNMENT SHIPYARDS.

BY OUR LONDON CORRESPONDENT.

In view of the experiments of the British Admiralty department, now in progress, to ascertain whether a private shipyard can build warships with greater speed than the government shipbuilding yards, the results in this direction in other countries afford interesting comparisons. In Germany and France battleship construction in both the private and state yards is very and unnecessarily protracted. And this delay constitutes a grave national danger which, it would seem, the respective governments do not adequately appreciate. In England, where, on the other hand, such work is carried out with all possible expedition, it has now become an axiom that "Great Britain can afford to wait until the Admiralty know the designs and efficiency of the projected vessels of other (European) nations before she commences to build a new vessel to excel them." In the case of the German battleship "Kaiser Karl der Grosse," a vessel 377 feet 4 inches in length and of 11,500 tons displacement, with four 9.4-inch guns and eighteen 5.9-inch guns, and with engines of 13,000 i. h. p., capable of developing a speed of 18 knots, she was erected in the private shipyard of Messrs. Blohm & Voss at Hamburg, and no less than 40 months and 5 days elapsed from the laying of the keel until delivered to the government. Even the Krupp firm, notwithstanding its modern and extensive equipment, are not much faster, since they occupied 35 months in building the "Zaehringen." With respect to the Imperial dockyards, they are quite as slow, since it was nearly four years before the "Wittelsbach," a similar vessel to the "Kaiser Karl der Grosse," was ready for sea. In France a similar state of affairs exists, but in this case the delay is more attributable to the uncertainty and hesitancy of the Naval Department, since the French government have a peculiar way of suddenly stopping work upon the construction of one vessel and directing operations upon another ship. But in the case of the three new battleships "Democratie," "Justice," and "Verité," which are each to be of 18,000 horse power, it is calculated that they will occupy four years in building. What is the result of this protracted construction? These three French battleships are of tremendous power, but progress in naval affairs and armaments is so rapid that by the time they are in commission they will be somewhat out of date.

In considering the practice in England, we find that although the government is comparaively slow in construction, everything is being done by the Admiralty to decrease the time occupied in building. The private shipyards, when they have a vessel in hand, crowd the workmen upon it, and get it off the ways as quickly as possible. The recent cases of the Chilean battleships "Libertad" and "Constitucion," and the new type of torpedo destroyer "Erne," offer striking examples of the speed with which battleship construction is carried out. The two first named, notwithstanding their large dimensions and displacement, were launched 10 months after the signing of the contracts, while the builders actually undertook to have the vessels complete and ready for use within 18 months; and if the speed of building with which they were commenced had been maintained, the contract time would have been shortened by one month. To build and equip a first-class modern battleship such as these Chilean war vessels, ready for action, within 17 months is a commendable achievement. In the instance of the torpedo boat destroyer "Erne," a record in quick construction was accomplished. This vessel was launched 7 months after the signing of the contract, and will be handed over to the English Admiralty 6 months below the contract time. Even in the government dockyards quick construction is the chief desideratum, though in this case the speed is not so great as in the private shipyards. But the English Admiralty are determined to cut down the time for building to the minimum, and they have now inaugurated a new system of decentralization, by which there is a superintendent for naval contracts. Speed in construction is the continual demand of the government, and it is furthermore a great national demand. For the battleship costing $5,000,000 upward, when launched, to be out of date, owing to the long time occupied in its construction, is a result which, in the interest of the citizens and the defenses of any country, should be remedied at all costs

"SHAMROCK III"

BY OUR GLASGOW CORRESPONDENT.

It seems to be inevitable that the building of yachts intended for "America" Cup racing should be attended, year by year, by the circulation of a crop of extraordinary stories regarding the appearance of the yachts, and the wonders which they may be expected to perform. The building of the boats now under construction has run to the usual accompaniment, and the British yacht has received, if anything, the larger share of the attention of the resourceful inventors of these rumors. Anyone who has been led by these stories to the expectation of some sensational development in the boat built at Dumbarton to carry Sir Thomas Lipton's third "America" Cup challenge, may be counted foredoomed to disappointment, for the yacht which has been evolved by Mr. William Fife, Jr., differs so little from recent challengers and defenders that it requires the trained eye of a practical yachtsman to identify the developments.

Such changes of type as have been made are, however, none the less important because they are unsensational. In the recent contests which have been sailed for this much-coveted trophy there has been a marked leveling of the abilities of the opposing yachts, and it has come to be recognized on both sides of the Atlantic that a runaway victory for either side is not among the things which can fairly be expected. The last contest, that sailed between Columbia and the Watson challenger, "Shamrock II.," was admitted on all hands to be the closest match ever made for Cup honors, and it would therefore have be[illegible] policy for Designer Fife, when called upon to [illegible] another Cup racer, to have ignored the devel[illegible] already made and to have struck out in the [illegible] of experiments of unknown value. This cons[illegible] should, of itself, have been sufficient to disco[illegible] of the rumors regarding the sensational deve[illegible] to be expected in the Scottish boat.

As a matter of fact the designer of "Sham[illegible]

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recognized the coming match as one in which the victory is likely to be gained by seconds and minutes, and the boat which he has produced shows that his line of action has been in recognizing and strengthening the weaknesses of the two previous challengers rather than in striving after a marked degree of originality. Generally speaking, it may be said that the chief novelty in the design of "Shamrock III.," lies in the fact that stiffness and great sail-carrying power, which have been the characteristic of each Cup challenger since and including "Valkyrie III.," have been treated on this occasion as a matter of secondary importance. All yacht designing is largely a matter of compromise. If a stiff, powerful boat is the main object of the designer, then the soft flow of the lines which give ease of driving must be sacrificed to some extent. In "Valkyrie III.," "Shamrock I.," and in less degree, in "Shamrock II.," the design was controlled by a desire to produce such a hull as would stand up well to the immense pyramid of canvas which it was proposed to use for driving. In the latest boat the controlling feature of the design has been altered, and Fife has apparently directed his energies first to the posed to use for driving. In the latest boats the conditions of weather. He has therefore given "Shamrock III." a round fullness of body which makes her stand out from the list of challengers as a yacht of marked individuality. The fin-keel type of underbody is naturally retained, but the hull of the boat is drawn so well down that the fin is made much shallower than usual. It is, in short, less of a fin and more of a keel than has been seen on any Cup racer in recent years. The draught has also been cut down to a considerable extent, and the new craft will float in two feet of water less than was necessary to keep the Watson boat off the bottom.

These changes mean naturally a certain loss of initial stability, and to partly compensate for this the beam, as compared with that of "Shamrock II.," has been slightly increased. The full round head which was characteristic of the Watson boat—and helped greatly to her undoing when she met a head sea—has no place in the Fife model. From the point of greatest beam the bow is carried forward in an easy sweep which gives an entrance cleaner than on any of the previous "Shamrocks." The excessive thinning down of the flanks, which was also a noticeable feature of the previous challenger, has also been avoided, and the beam of the boat is carried well out into the counter. In profile the yacht has fewer peculiarities. The bow is shorter and sharper than usual, and rises at an angle that should keep the decks moderately free from water in anything less than a heavy sea. The sheer is peculiar, and looks ungraceful to eyes accustomed to the low waist and the rise fore and aft to which yachts are usually sheered. The rail of "Shamrock III." is practically level.

In the construction of the boat Messrs. Denny Brothers have produced an interesting bit of work, but the interest lies mainly in the details and the quality of the workmanship rather than in the introduction of any new principles. In the matter of material, the boat might be regarded as a retrogression, for the manganese bronze with which the last Cup yacht was plated is discarded in this instance for nickel-steel, such as is largely used in the construction of launches and torpedo boats. The builders, on whose advice this was done, are, however, convinced that this is a step in the right direction. The difficulty of working the manganese bronze and the extra thickness necessary to make up for the doubtful hold of the seams, etc., more than compensated, in their opinion, for the superior smoothness and other advantageous qualities of the alloy. The present yacht is plated from keel to rail with nickel-steel. The plating used in closing in the underbody, where a little extra weight is of little account, is fairly stout, but from the waterline up, where every pound tells against the stability of the boat, the plating is so thin that it is difficult to understand how a satisfactory bedding has been got for the countersunk heads of the rivets. The only aluminium used in the vessel has been put into the decks, whose plates are composed of an alloy which is mainly this light, but perishable metal. Taken as a whole, and allowing for the weight saved by the use of thinner metals, the shell of the boat is lighter than that of "Shamrock II." and works out at a figure very close to that of the first Fife challenger.

In a yacht of this type the spars are always deserving of special attention, as much from their great size as from the ingenuity displayed in the effort to secure the maximum of strength and rigidity with the minimum of weight. In this, Fife had the experience of the last challenger to guide him, and he has made few departures of note. The mast, gaff, and boom are of steel, the bowsprit being solid wood, and the lighter spars of hollow wood. The mast follows the idea carried out in the second spar of this kind fitted to "Shamrock II.," in being mainmast and topmast in one unbroken length. The reason for this is the saving of weight and windage as compared with the ordinary main and topmast, and the saving of weight and complication of gear as compared with the Herreshoff system of telescoping spars. All the steel spars are constructed on the same principle, a framework of light angle steel being first laid down, and bound and strengthened by a series of short straps zigzagging across the diameter of the spar. The complete skeleton is then closed by light steel sheets bent to shape and riveted.

On this occasion there has been abundance of time for the performance of the work; every detail was subjected to searching inspection, and the result is a boat that, whatever her sailing qualities may prove, should at least have none of the weaknesses which helped to mar the career of the second "Shamrock."

THE SECOND EAST RIVER RAPID TRANSIT TUNNEL TO BROOKLYN.

Plans recently submitted to the Rapid Transit Commission by their Chief Engineer for the improvement of traveling facilities in Brooklyn include the construction of a second East River tunnel from Nassau and Orange Streets, Brooklyn, to Maiden Lane, in Manhattan. The tunnel will terminate at a station near William Street, from which point two lines will be run, one across Manhattan to West Street at the foot of Cortlandt Street, and another line below William Street and diagonally beneath the Brooklyn Bridge structure to Park Row, whence it will proceed by way of Center and Grand Streets, to the Manhattan terminus of the Williamsburg Bridge. Here connection will be made between the subway tracks and the tracks which pass over the bridge. It will be seen that this second line will provide a loop for the Brooklyn railways by way of the new tunnel and the Williamsburg Bridge.

Mr. Parsons also recommends removing the elevated trains from the Brooklyn Bridge, sending them across the East River by the new route, and transferring the trolley cars from the roadways to the bridge railroad tracks, thereby restoring the roadways to the exclusive use of vehicles. It is also proposed to connect the two bridges by adding two tracks to the Second Avenue Railroad, and building a new branch of the elevated system down Delancey Street to the Williamsburg Bridge. If these suggestions are carried out, Brooklyn and Manhattan will be connected by three bridges carrying six elevated tracks and ten surface tracks, and by two tunnels carrying four tracks. The report also recommends for Brooklyn a new subway system and a development of the elevated railroad system. From Flatbush and Atlantic Avenues, the terminus of the tunnel now under construction, it is proposed to build a four-track subway to the Prospect Park plaza, with a loop at the plaza, and from this loop to carry a three-track line easterly below Eastern Parkway and East New York. Another proposed extension is to run from Flatbush and Atlantic Avenues below Fourth Avenue to Fort Hamilton. In addition to these extensions of the subway system, the report proposes no less than nine new elevated lines or extensions of existing elevated lines. The cost of these improvements exclusive of abuttal damages will be about $52,000,000; $31,000,000 being for the subway system and $21,000,000 for the elevated system extensions.

SPICES—PURE AND OTHERWISE.

BY A. S. ATKINSON, M.D.

Spices properly used have their value in helping digestion and stimulating the flow of the gastric and pancreatic juices, and at the same time they tempt the jaded appetite to a better relish of good, wholesome foods. But spices are not always what they are sold for; neither are they always as wholesome and harmless as they should be. The tendency to adulterate extends to nearly all our foods, and unfortunately a good many people in buying cheap foods are not getting all they bargained for.

When adulterations are wholesome or harmless, possibly the deception is not so bad, especially if we cannot distinguish by taste the genuine from the artificial. Naturally dealers and manufacturers in adulterated foods try to select harmless articles to mix with their adulterated goods. Whatever the nature of the material used for adulterating, it is always cheaper than the genuine goods. It is usually some woody substance, which when ground fine enough will pass muster without being easily detected. Thus in such spices as cloves, cinnamon, mace, allspice, nutmeg, mustard, and ginger, there are many such materials as ground cornmeal, parched wheat, peas, beans, and coffee beans, which can easily be mixed with them without changing the general appearance or even taste beyond lessening the strength. As some people like chicory in their coffee, so some people might prefer adulterated ginger and mustard to the full strength of the genuine article. If the adulteration is to be done, however, it is much more desirable that it should be done at home than in the store.

Ginger, for instance, is frequently adulterated with pepper, mustard hulls, and turmeric. These give nearly as sharp a taste to the mixture as pure ginger would, and the effect is that the adulterated spice frequently passes unchallenged. Cinnamon has quite a variety of materials used for cheapening its retail cost. Cassia, arrowroot, mustard hulls, charcoal, burnt shells and cracker dust are all frequently ground to swell the bulk of the spice. Then in cloves we have some of these same materials, and such other articles as clove stems and hulls ground up, allspice, peas, wheat, and even mineral colors. Nutmegs, since the days of the first Yankee nutmegs made in Connecticut of white birch colored to resemble the natural ones, have been susceptible to considerable adulteration, and starch, cereals, mustard, peas, and other roasted articles go to make up ground nutmegs. Of course, whole nutmegs are hard to imitate, but even these are sometimes sold as genuine when they are nothing but wild, flavorless nutmegs.

Pepper has its weight increased with the addition of such cheap and harmless substances as bran, peas, rice, corn, charcoal, mustard hulls, sago, arrowroot, and cocoanut shells. None of these add any spicy flavor to the combination but they serve to enhance the profits of the maker. If one had the time to separate these different articles of adulteration and examine them carefully through a microscope, he would easily see the deception practised upon him. A good many dealers will tell you that harmless adulteration like this is liked by many people. They prefer the mixtures and blends which they put up, and therefore it does no harm. It is a good deal like coffee and tea blends which dealers mix for their customers, using cheap grades with the high grades, and then selling the results at the highest prices. This may be partly true, but no deception can be practised continually without causing some danger.

For instance, some spices act as a special poison to many people. The mere touch of ginger in one person's food is sufficient to cause nausea and great suffering. Cinnamon to another acts like a mild but quick poison, and mustard in any form will cause another to break out in red, prickling spots. All these spices when mixed together, or adulterated one with another, might be the contributing cause to a person's illness and death. For instance, the person using pepper may be easily affected by mustard, and if the pepper is adulterated with ground mustard hulls the damage is done. Ginger is sometimes mixed with mustard, and the result in using these two together might develop strong symptoms of poisoning.

One cannot afford to take into the system anything under a disguised name. The modern man and woman of intelligence have studied their diet sufficiently to know what disagrees with them, and they do not care to have anything smuggled into their stomachs under some fraudulent name. To many the chances of harm from such a source appear very remote indeed, and they discard them from serious consideration; but to others it is a matter which seems not so slight. It makes a difference whether one is in delicate health or strong and robust in flesh. The former cannot take risks that the latter might daily face in his eating with perfect impunity.

SCIENCE NOTES.

A civil war record of the height of Indiana soldiers shows that out of 118,254 there were 15,047 5 feet, 10 inches tall; 8,706 5 feet, 11 inches; 6,679 6 feet tall; 2,614 6 feet, 1 inch; 1,357 6 feet, 2 inches; 406 6 feet, 3 inches; and 330 over 6 feet, 3 inches. Commenting on these statistics, Dr. Gould, Actuary of the United States Sanitary Commission, writes: "It is evident from our statistics that the Indiana men are the tallest of the natives of the United States, and these latter the tallest of all civilized countries."

Silk is known to be the secretion of two glands of the silkworm alongside of the digestive canal. These glands, which consist of tubes in numerous coils, terminate in the spinning-wart, and open in a common orifice from which the secretion, of the consistency of honey, issues forth, promptly hardening into a thread on exposure to the air. Usually the silk is colorless on leaving the body of the silkworm, but sometimes it is straw yellow or greenish. There has been a dispute of long standing between the savants as regards the origin of this coloration. Some claimed that the larva itself produced the color, others ascribed it to impurities which it acquired upon secretion, and still others were of the opinion that the green color of the leaves of the mulberry tree was the cause of the coloring. The last-named opinion seems to be the correct one. Latterly, Levrat and Conte fed silkworms on mulberry leaves which had been saturated with non-poisonous aniline red and aniline blue. The result was that not only the silkworms turned red or blue, but they also secreted silk of the respective colors. Injections of the above-named dyestuffs into the anal organ of the silkworm produced the same result.—Die Seide.

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THE MONTREAL GRAIN ELEVATOR.

In a recent issue we published an article describing the "grasshopper" elevator for the handling of grain in harbors, and especially for raising grain from the holds of vessels and delivering same in any desired locality. We take pleasure now in presenting to our readers one of the most modern and best-equipped storage elevators erected on this continent.

The contract for the elevator was awarded April 16, 1902, by the Harbor Commissioners of Montreal. The design for the elevator was prepared by the Steel Storage and Elevator Construction Company, Buffalo, N. Y., and, before awarding the contract, the plans were submitted to the Minister of Public Works for the Dominion. At his direction, a board of experts examined into the plans very thoroughly and were unanimous in their approval. The time specified for completion of the elevator is August, 1903. The elevator foundations, lower story, and all upper floors are built of concrete. The bins are cylindrical in shape, built of steel plates, with all spaces between cylindrical bins formed into smaller bins, so that the whole area is utilized for storage. The total number of bins is 78; and the total storage capacity, 1,000,000 bushels.

The marine tower is built of steel, and is 23 feet wide, 33 feet long, and 150 feet high; it will be mounted on twenty pairs of car wheels running on four steel rails along the dock.

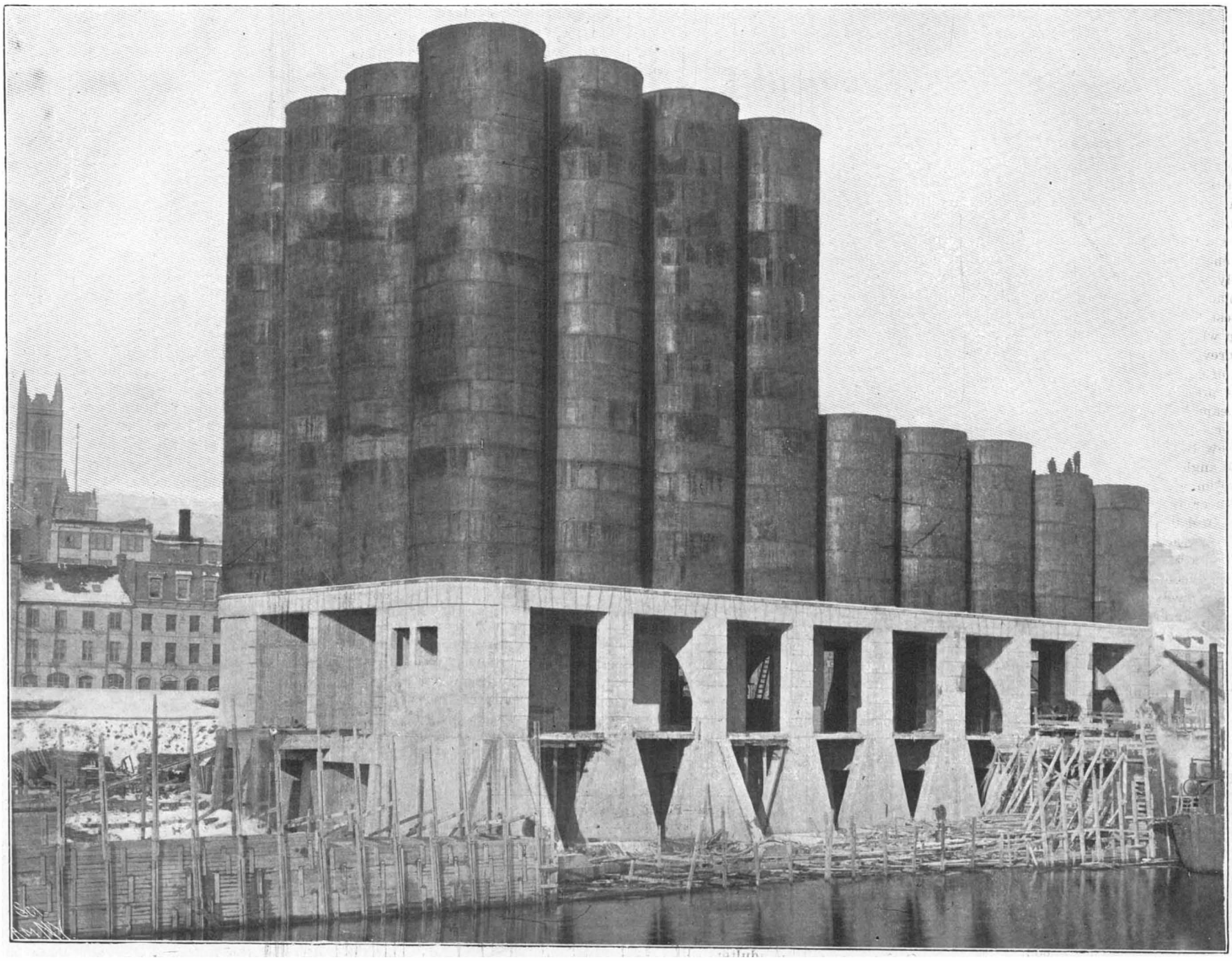
This dock is now being built by the Steel Storage Company. It consists of a middle section in front of the elevator, which will be built entirely of concrete and steel construction, supported on piles. The width of this section of dock is 33 feet, height 25 feet, and length 200 feet. At either end of the middle section is a heavy concrete retaining wall with filling behind, which will form the dock beyond the elevator. The total length of concrete dock is 600 feet, running across the inshore end of the basin between the two adjacent steamship piers. The total height of the concrete work under the elevator from pile heads to bin bottoms is 50 feet. About 25 feet of this will be below grade when the filling is completed. Two car tracks run through the elevator.

This lower concrete story is thoroughly braced by heavy concrete arches running entirely across the building, with buttresses extending out on either side to take the thrust. The space between columns, as shown on our illustration, will be filled by a concrete curtain wall with a double window, three sashes high, in each panel, which will make a very light lower working floor. The entire outer surface of the concrete will be blocked off to resemble massive masonry, and bush-hammered all over. The top of the bins, as shown in the engraving, will be 110 feet above ground level, and the cupola will run 85 feet above this, making a total height from the ground of 195 feet.

This cupola will be structural steel throughout, with concrete floors and roof. The elevator will be equipped to receive grain either from boats or cars, and ship grain either by cars or by means of conveyors to ocean boats lying at their berths at either King Edward, Alexandria, or Jacques Cartier piers, and at the basins between these piers. The total number of berths served by this elevator will be fifteen. The total length of conveyor to be installed in connection with this elevator for loading ocean boats will be over 9,000 lineal feet.

The handling capacity will be: Receiving grain from boats, 18,000 bushels per hour. Receiving from cars, 20 cars per hour. Shipping to vessels by means of conveyors, 80,000 bushels per hour. Shipping to cars, 48 cars per hour. The elevator is designed so that a second movable tower can be built at any time, with the effect of doubling the receiving capacity from boats, or, in other words, raising it 36,000 bushels per hour. It is the intention to build this extra tower as soon as the business of the port demands it. The elevator, if working only one-third of the time during the navigation season of 150 days, would be capable of receiving and shipping more than 18,000,000 bushels.

The whole building will be thoroughly lighted by incandescent electric lights. The elevator will have a complete dust-collecting and burning system. It will also have an electric passenger elevator, washrooms and office for foreman, and all conveniences to make it complete. The cleaners installed in the elevator will be specially constructed of steel throughout, so as to be absolutely fireproof. All machinery in the elevator and conveyors will be driven by electric motors, and the total horse power represented by these motors, when the conveyor system is complete, will be about 2,500. The current will be furnished by one of the power companies doing business in Montreal. In the elevator will be a transformer station and switch room for controlling all the motors.



ERECTING THE MONTREAL STEEL AND CONCRETE GRAIN ELEVATOR.

The World's Inventors.

The Patent Office statistics inform us that the Britons are the most inventive of all foreigners; that for the year 1901, the patents issued to British inventors numbered 999; while the Germans, in spite of the advantages of quieter surroundings, come forward with only 743 inventions. It is granted that the Americans are the leading inventors, and naturally our cousins on the other side are next in line. The Connecticut people are supposed to be the most inventive of all. Benjamin Franklin was a Bostonian, Samuel F. B. Morse and Elias Howe were New Yorkers. George M. Pullman lived in Cook County, Ill. The Maxims are Maine men; Thomas A. Edison comes from Ohio, and the world-frighting Gatling opened his eyes in the South.

Patents tell only a part of the story. They have nothing to say about those wonderful airships (our foremost theorist on air sailing is a Bostonian, Samuel Pierpont Langley) that always go to smash just before whirling around the vast empyrean, or about the still more wonderful perpetual motion machines, or about the yet unattempted desideratum (greatest of all, perhaps)—a machine to rock and sing the baby to sleep. The world is yet at the mercy of infants and nurses. Nor do patents tell of the inventors of gods or goddesses in the East, or of the inventors of romances that publishers will not take a chance with.

As for Connecticut's reputation, however, it will endure forever and brilliantly, if for no other reason than that the prince of Yankee inventors, the Hon. Phineas T. Barnum, author of "The Humbugs of the World," hailed from Bethel and lived to be mayor of Bridgeport and the head of the "Greatest Show on Earth."—Washington Times.

By-product coke ovens are coming more and more into general use, and at nearly all the establishments where they are being utilized, extensions are being made in this particular. In a short time there will be 1,310 of these ovens in use.

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BULL'S SELECTIVE SYSTEM OF WIRELESS TELEGRAPHY.

BY A. FREDERICK COLLINS.

Since the recent successful tests in cableless telegraphy have proven beyond the peradventure of a doubt the feasibility of long-distance transmission, greater effort than at any time heretofore has been made to solve the difficult problem of syntonization.

In nearly every system except the one under consideration, syntonic or selective wireless telegraphy has been based on the principles of electrical resonance, in which the resonator is made to respond sympathetically to the emitted waves of the oscillator in virtue of the similarity of their electrical dimensions.

It is easy to show theoretically the action of a syntonic system based upon the parity of the coefficients of the oscillator and of the resonator as exemplified by a given receiver responding to a given transmitter, and it may likewise be shown by actual experiment that the deductions upon which the theory of resonance was evolved are correct.

But in applying these principles practically it has been found that there are other factors which must be reckoned with, and as these are not constant a serious obstacle is at once brought prominently into evidence. As an illustration of the foregoing statement, in a practical system of wireless telegraphy one side of the oscillator and one side of the resonator are connected with the earth; now the earth acts as a capacity, and as such it varies constantly and so changes the whole system connected with it.

To avoid these difficulties Mr. Andres Bull has designed a system which operates mechanically and in which the dimensions of the sending and receiving circuits are not factors controlling the matter of selection, but instead a fixed number rate of wave impulses actuate different receiving instruments in accordance with prearranged time intervals.

The instruments employed in the Bull system of selective wireless telegraphy are shown in the photographs, Figs. 1 and 2. The "disperser" and "collector," as Bull terms the transmitter and receiver, are combined in the apparatus illustrated in Fig. 1, *A*. This mechanism is connected by means of gearing to an electric motor, *B*, the speed of which is controlled by a Siemens & Halske brake regulator, *C*. The device represented by *D* consists of an electro-magnet connected with and automatically controlling the disk referred to. Fig. 2 shows a number of Morse registers connected with the collector or receiving apparatus.

In transmitting a wireless message an ordinary Morse key is employed. When the key is closed the current from the battery, 1, Fig. 3, flows through and energizes the electro-magnet 2. This attracts an armature, to which is attached a clutch, the side elevation being shown in Fig. 4. Attraction of the armature serves to draw the clutch out of engagement with a pin, 4, on the disk, 3, and this permits the disk to rotate by frictional contact with the shaft, 5, at a speed of about five revolutions per second. In the course of each turn of the disk the pin, 3, closes the circuit, of which the battery, 7, and the electro-magnet, 8, form a portion, through the medium of the contact springs, 6.

If it is desired to send a dot the key is made to close the circuit for a period of less than one-fifth of a second, so that the clutch will engage the pin and bring the disk to a stop as soon as it has made one complete revolution. Thus the current flows through the circuit, which includes the magnet, 8, in the form

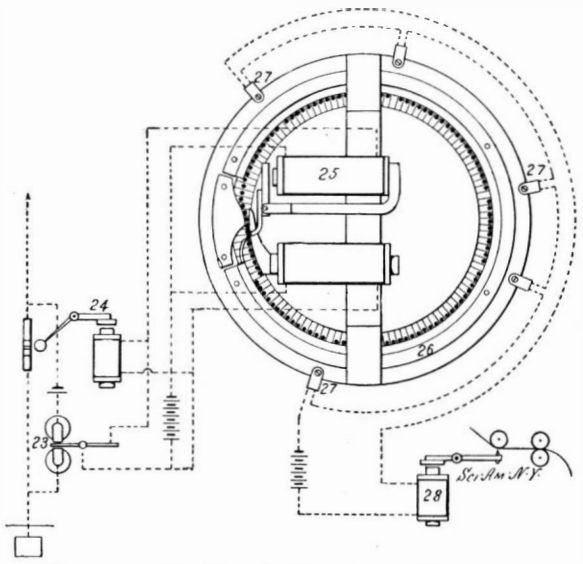

Fig. 5.—The Receiver, Showing Connections Between Coherer Relay, Morse Register and Collector.

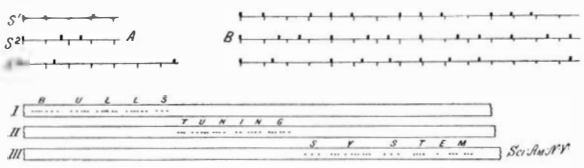

Fig. 6.—Diagram Showing Impulses of Series and Specimens of Tape.

of a single impulse. When it is desired to send a dash the key is held into contact for a sufficient period to permit the disk to revolve several times, when successive current impulses flow through the circuit at intervals of one-fifth of a second. This actuates the transmitter or disperser, consisting of a disk to which are attached four hundred steel springs, 9, positioned vertically near the periphery. The free ends of these springs pass through radial slots (as shown in Fig. 3) in an upper and oppositely disposed disk, 10. These slots permit movement of the springs relative to the disk in a radial line only. The disks are mounted on the same shaft or spindle, which in turn is mounted vertically in the frame of the disperser. The shaft is rotated at the rate of one revolution per second. A brass ring, 11, is secured to the frame and serves as a guide for the spring points, 9, so that when the disk revolves they slide either within a U-shaped groove, 12, formed by the ring or within the ring itself.

Referring again to Fig. 3, a bronze arc, 13, whose ends conform to the angle described by the dotted lines, *a*, is inserted in place of the brass ring at that section. The bronze piece, 13, has a projection extending toward the concentrically arranged springs, and causes these springs in traversing this section to bend toward the polar projection of the magnet, 14, which then attracts them, being constantly energized by a current from the battery, 7. Thus attracted, the springs slide along the projection until the edge, 15, is reached, when they are released and instantly spring back into their normal position. As the disks continue to revolve, the steel springs simply slide within the ring, 11. This is the normal process which takes place when the magnet, 8, is not energized; but if the electro-magnet, 8, is excited the armature to which the finger, 16, is attached will be swung forward so that it projects slightly in front of the polar projection of the magnet, 14. When this occurs the springs in clearing the finger, 16, are forced from the pole of the magnet, 14, when they will again assume their vertical position in virtue of their elasticity and will pass into the U-shaped groove at 17, remaining there until the disk has completed its cycle.

The purpose of this device is to establish contact at certain prescribed intervals with the induction coil, 20, and the oscillator which emits the electric waves. This is done by means of a number of contact points, 18, fitted to the circumference of the frame supporting the disperser; these consist of two contact springs insulated from each other; when the steel springs, 9, move within the ring, 11, they just clear the contact springs, but when passing in the U-shaped groove, 12,

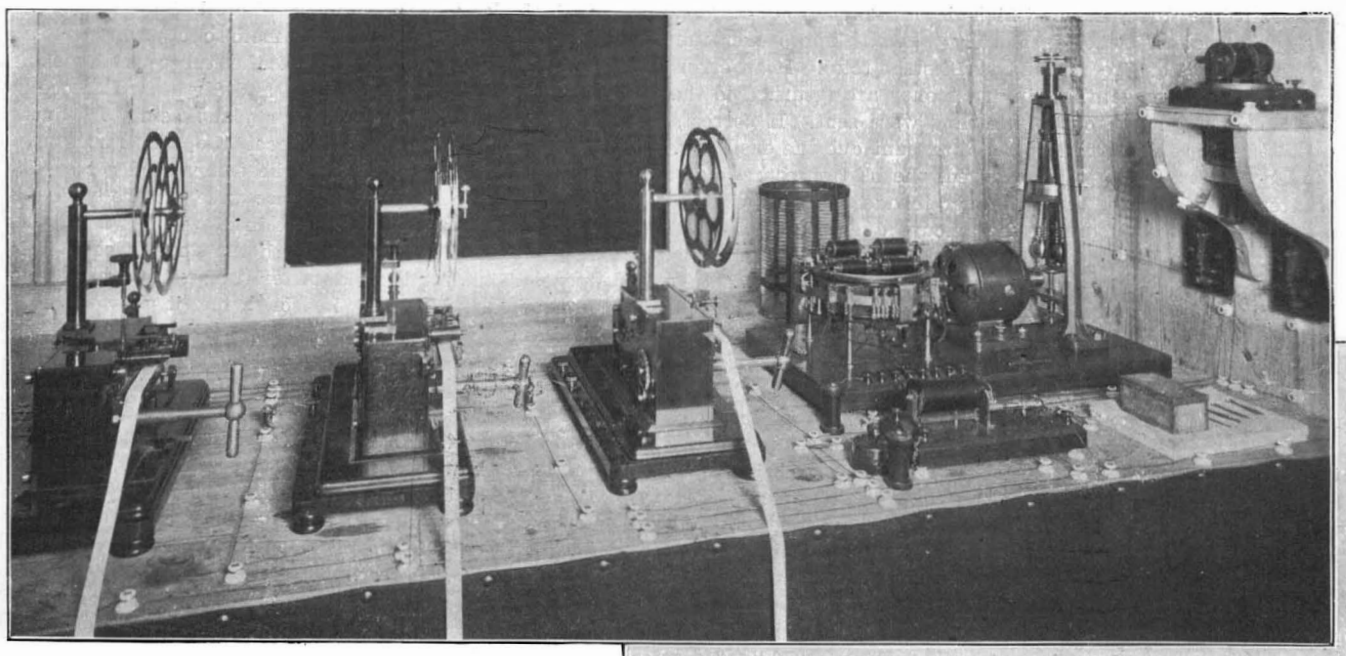

Fig. 2.—The Receiving Station.

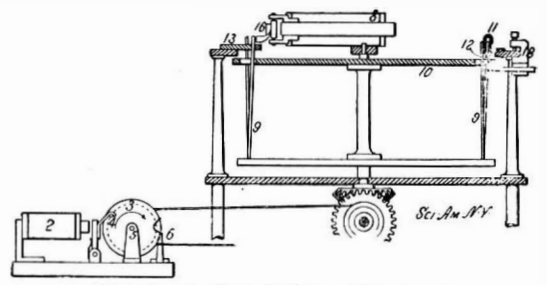

Fig. 4.—Sectional View of Disperser.

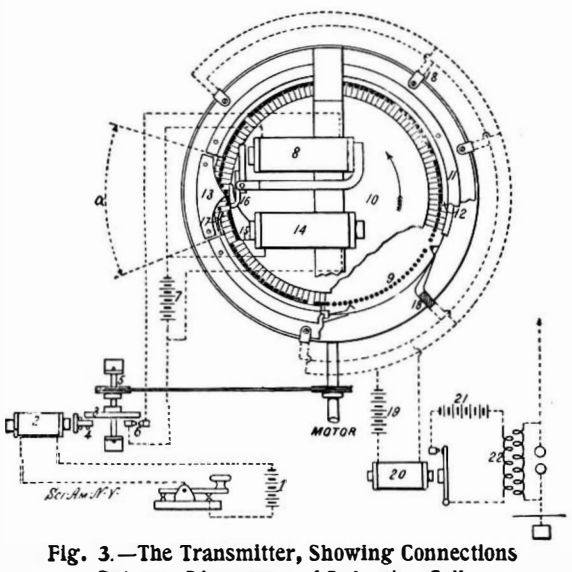

Fig. 3.—The Transmitter, Showing Connections Between Disperser and Induction Coil.

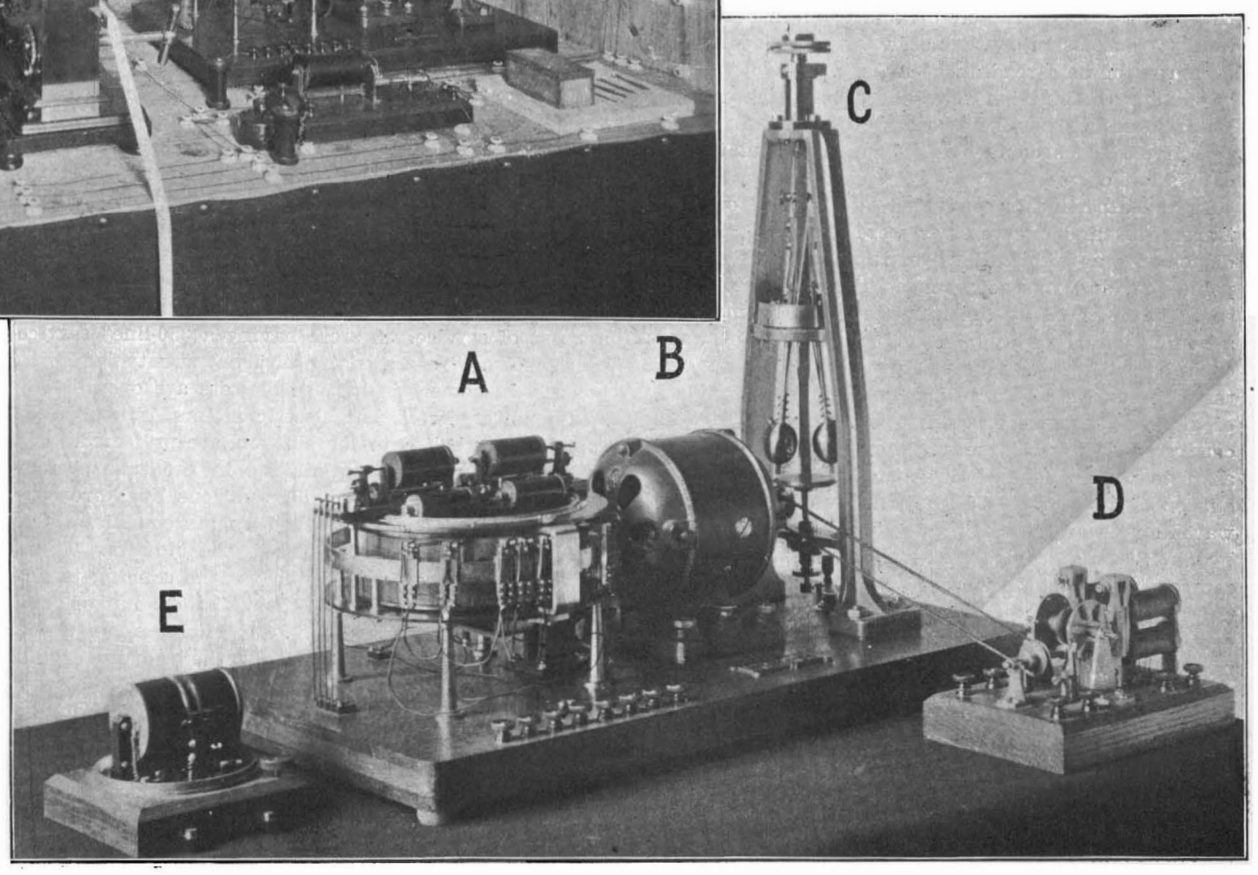

Fig. 1.—Main Apparatus of the Bull System of Selective Wireless Telegraphy.

THE BULL SELECTIVE SYSTEM OF WIRELESS TELEGRAPHY.

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they project sufficiently to make contact and therefore close the circuit operating the induction coil.

If the magnet, 8, is not excited and the disk is revolved the steel springs will slide within the ring and all the contact points will be open; if on the other hand the key is closed and a current impulse is sent through the magnet, the steel springs sliding through the groove make connection with each of the contact points in passing them. The electrical connections between the steel springs and the contact points and the induction coil and oscillator system is clearly shown by the dotted lines and it is evident that upon contact being established between a steel spring and the points the circuit will be closed and the current from the battery, 19, will operate the magnetic circuit closer, 20, thus causing the current from the battery, 21, to flow through the primary of the induction coil, 22, when a disruptive discharge takes place through the spark gap and electric waves are emitted. Now for every current impulse that flows through the disperser magnet, 8, by means of the key, 1, a series of electric waves are radiated, which equal the number of contact points, 18, and since the disks revolve at approximately constant speed the time intervals between a series of impulses will be proportional to the angular distances between the contact points, and thus by varying the distance between these points and by arranging these at different positions around the frame of the disperser the series of impulses or waves may be varied at will and within wide limits. When the electric waves thus emitted impinge upon the receiving antenna (Fig 5) the normally high resistance of the coherer is instantly lowered and the local current flowing through the coherer and relay magnets, 23, actuates its armature, closing an auxiliary circuit in which is included the decoherer, 24, for tapping the filings back to their normal resistivity, and the collector magnet, 25, which is in shunt with the tapper. The collector, as the receiving mechanism is termed, is constructed on the same principles as the disperser, Fig. 3, in fact they may be substituted one for the other by means of proper cut-outs. It will therefore be clear that for each series of impinging waves a steel spring is brought into the groove of the ring, 26. The disk of the collector, to which the steel springs are attached, revolves at a speed isochronous, practically, with that of the disk of the disperser; hence the angular distances between the springs brought into the groove will be proportional to the time constant between the series of electric waves received by the antenna; e. g., if five electric wave series are transmitted, five springs will be brought into the groove of the collector at angular intervals representing the intervals of time between the series of waves. The points, 27, making contact in the collector are arranged in the same relative positions as they are in the disperser, the springs moving in the groove forming the controlling contacts; these are connected in series with the Morse register, 28, and consequently contact is made by all the points simultaneously. Now when the mutual angular value is the same for the points and the springs a prearranged series of electric waves will bring the latter into the groove, and as the disk revolves the series of steel springs, corresponding to the series of waves, will make contact simultaneously at all points; the battery current operating the Morse register then flows through the circuit and prints a dot on the tape. A succession of wave series will produce a dash, or a row of dots reading as a dash. Wave series of any other combination than those to which the collector is adjusted will not operate the Morse register, for simultaneous contact is not possible and the circuit is left open.

In the experiments conducted by Mr. Bull only one transmitter and one receiver were employed, but the disperser was provided with three sets of contact points, 27, and was so arranged that any set desired could be operated by the induction coil, by means of a switch, and thus any one of three series of waves could be emitted and received at will. Uniformly with the diperser the collector was equipped with three sets of similarly arranged contact points, each set being connected with a Morse register, enabling the operators to use any one of three combinations to the exclusion of all others. Three series or combinations of waves only were required, as shown diagrammatically by S^1, S^2, and S^3, Fig. 6 *A*. The element of time is represented by the horizontal line and the wave series or combinations by the vertical heavy strokes; the equi-distant spaces marked by the vertical lines designate 0.05 of a second. At *B*, Fig. 6, is illustrated how the wave series are registered rhythmically when the key is kept closed. By this arrangement selective wireless messages were sent and received with accuracy and dispatch and were printed in Morse characters on the tape of that register only for which it was intended, the other two machines remaining inoperative. Specimens of the tape from the three registers are shown at I., II., III., Fig. 6, each of the three series, S^1, S^2, and S^3, being employed successively. The speed attained approximated fifty letters per minute.

This is the first time in the history of wireless telegraphy that three messages have been transmitted and received simultaneously and selectively and it is also the first time in the history of the art that mechanical methods have been successfully employed in obtaining selectivity. The sending and receiving instruments may be set up at different points and at varying distances, which is a decided advantage over those systems based on pure electrical resonance.

THE PNEUMATIC TUBE SYSTEM OF A MODERN DEPARTMENT STORE.

BY DAY ALLEN WILLEY.

The use of pneumatic tubes in transmitting money, papers, and parcels of various kinds has become so extensive that the service is considered a necessity in the equipment of the modern mercantile establishment. The plan is not a new one. Improvements, however, which have been made in the system in the last two or three years have greatly increased its practical value. In the dry goods or department store, for example, it is valuable as a labor saver, dispensing, as it does, with the many cash boys, in some instances cash girls, that have been employed, and performing their work much more quickly, besides avoiding many mistakes which formerly occurred. There is no delay in "making change," as the amount due the customer is usually handed him by the salesman within a minute, sometimes less than a minute, after his money has been taken over the counter. The system also assists in checking or auditing the sales, for the charge or cash slip which represents the amount of the transaction is sent to the cashier or bookkeeper, where it is examined and verified before being returned.

In the ordinary store the pneumatic tubes extend from the cashier's and bookkeeper's departments to the principal sales departments, varying, of course, in number according to the extent of the establishment. Each tube is termed a "line" and is usually 2¼ inches in diameter. The tubes are generally extended along the ceiling or under the floors for the purpose of economizing space, and the terminals where the carriers are received and sent are of various shapes adjusted to suit the conditions. The system is so laid out that when a sale is made the clerk prepares his purchase check, gets the money from the purchaser, and places it in a small brass cylinder which can be unscrewed at the end merely by a twist of the fingers. To start the carrier, it is necessary only to insert it in the receiving end. The air forces it through the line to what is called the main station. This is usually in the cashier's office, for so many articles in the retail store are sold for cash that no entry is required. The carrier drops into the open receiver at the end of the tube, from which it is taken by the "change maker," who, as already stated, glances over the figures on the slip and verifies the total. If an error has been made, the slip and money are returned to the department from which they were sent. If correct, the slip is returned with the amount due the customer. If the sale is to be charged, the slip of course contains the name of the customer in addition to a description of the article and the amount due. As soon as it has been examined, the clerk in the cashier's office again places it in the carrier and inserts it in the tube or line connected with the bookkeeper's department. Here the memorandum is taken out, entered on the books, and either the original slip or a duplicate is returned to the salesman.

These operations are usually performed in less time than it takes to read the description; for the carrier travels at a rate varying from 1,000 to 2,500 feet per minute, according to the air current. The length of a line is seldom over 600 feet. The current is produced by the blower system, and the mechanical plant installed provides for a force representing from one-fourth to one-half horse power to each line, depending upon the number of bends or curves and the amount of service. A store having a "50-line" service therefore requires an engine of about twenty-five horse power. In some systems the blowers are operated by steam power direct, but electric motors, either direct connected or bolted to the blowers, are preferred.

The air current is maintained in the tube system in the following manner: The various lines are connected with what may be called a main conduit, which leads to the engine room and to the blowers. These blowers draw the air from the various sending terminals of the line, expelling it through a conduit of suitable size, which may open in the engine room or be connected with the street. While the velocity of the current varies according to the speed of the blower fans, the minimum is rarely less than 2,500 feet per minute, the pressure in the tubes ranging from 6 to 12 ounces per square inch, the latter pressure being secured with a service of one-half horse power. The principle is simply the exhaustion of the air in the tubes to produce a partial vacuum. The effect is so powerful that, although the carriers and their contents weigh a half pound, they are transported without difficulty. The suction is not apparent twelve inches from the end of the receiver. Consequently, the end of the receiver can be placed over a desk or table on which light material, such as paper or currency, is spread. Incidentally the system is of considerable value from a hygienic standpoint, as it assists in the ventilation by continually changing the air in the apartment where the terminals are installed.

The carriers are merely cylinders of sheet brass covered at each end with felt to protect the metal from abrasion in passing around the elbows of the tube. They range from four to six inches in length for the ordinary store service, but do not fit closely against the side of the tube. Enough space is provided to allow the carrier to be borne along by the air current with little or no friction except at the turns, thereby permitting of a much greater speed than if the carrier acted as a piston and was continually in contact with the tubing. The receiving terminals are of two kinds, although both work automatically. The ones used in the cashier's and bookkeeper's department are merely open tubes, which are usually suspended over a receiving table or desk. An air valve is placed in the receiver at a point three or four feet from its end. This is so adjusted that merely the pressure of the carrier against it opens the valve. The carrier then drops by gravity to the end of the receiver, and is taken out by the cashier's clerk or bookkeeper. As soon as the carrier passes, the valve is shut by a spring, and thus the current is confined. The air is then diverted into a parallel tube connected with the sending terminal, the operation of which has already been described. The return tube to the sales department also terminates in the valve, which is located directly at its mouth. When the carrier is sent back, its impact is sufficient to open this valve, and it drops upon the salesman's table, the valve closing automatically and confining the air current as in the other instances. The system in the cashier's and bookkeeper's department requires some one to take the carriers out, in order that they may be examined as they are received, thus preventing unnecessary delay in making change. As the extent of the service is limited only by the power of the blower plant, some of the pneumatic systems which have been installed in department stores recently constructed are very extensive. Perhaps the largest in the United States is located in Philadelphia. It consists of over 250 stations, each connected with a line varying from 400 to 500 feet in length. A plant of 150 horse power is utilized, and in all nearly 20 miles of tubes are used. The power is sufficient to force the carriers through every line as rapidly as they can be inserted in the tubes.

Carriers of three and four inches in diameter are employed for transmitting papers and small packages in factories and warehouses, where bulkier material is required to be transferred from one portion to the other. The arrangement of the tubes is the same, and the carriers are received and dispatched according to the same plan, the power plant being of course, correspondingly larger to meet the requirements.

Not only the blower, but the compressed air system is utilized in the long-distance tube service which is employed by the government in New York and other large cities in connection with the Post Office Department. Thus far the plants for transmitting mail have been principally used in conveying it between New York and Brooklyn by way of the present Brooklyn Bridge and between the main post office in New York and the Grand Central Station. Here carriers which are 10 inches in diameter and about 3 feet in length are employed. The most extensive installation of this kind, however, is in operation in Boston, extending from the retail shopping district on Harrison Avenue to Back Bay, South End, Roxbury, Dorchester, and other sub-stations. This system conveys carriers which are 10 inches in diameter. The tube is laid underground, and consists of ordinary cast-iron water pipe finished at the joints in order to make a close fit. It is laid like a water conduit, with lead and iron joints, the curves being of 12 feet radius to the center line. The bends were cast in sections, the standard of 90 degrees comprising three 30-degree sections bolted together. The carriers which, as might be imagined, were manufactured especially for the purpose, consist of sheet metal riveted together, but move through the tube on wheels, five of which are placed at each head. The carrier is opened at the side by a hinged door. On account of size and weight, the terminals are of special design. The receiving terminal consists of an air cushion closed at one end by a revolving valve, opened and closed by a cylinder and piston operated by the air from the tube. Ordinarily this valve is closed, but when a carrier enters the receiver, it compresses the air in front of it. This pressure affects a small auxiliary valve. When the carrier is brought nearly to rest, the auxiliary overbalances and moves the controlling valve of the main cylinder. This opens the revolving valve, and allows the carrier to roll out. Just at the end of the receiver two vanes are mounted, so that the pressure of the air behind the carrier tends to move them. This motion is made

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use of to restore the auxiliary valve to normal position and close the receiver. The carrier is placed in the tube by moving valves connected with an air lock.

The power for this system, which is over ten miles in length, is compressed air, the service requiring about 1,400 cubic feet per minute, the pressure varying from 1¾ pounds to 2 pounds. Before entering the compressors the air passes through a tank filled with calcium chloride, which effectually removes all moisture. This tank is open to the atmosphere, and the pipe connections are so arranged that the air of the incoming line passes through the tank and returns to the compressor. Only such air has to be dried as is lost through leakage or used for operating the machines. The compressors are duplex belt-driven with 21-inch x 12-inch cylinders. There are two each at the main, South End, and Roxbury stations, and one each at Dorchester and Back Bay. The compressors are driven by 50 horse power, three-phase induction motors of the internal resistance type.

The system has been found to be an excellent substitute for wagons and other methods of delivery, and is largely used by merchants for sending parcels to the residence districts where sub-stations are located. At these they are sorted and distributed to the houses of the customers by teams and messengers. It is found that the average time required to deliver packages from the main station to any portion reached by the service is ten minutes, where from forty-five minutes to an hour would be required by the usual method of delivery.

The pneumatic postal tube system of New York city has been fully described and illustrated in the columns of the SCIENTIFIC AMERICAN.

Correspondence.

Interest in the Jane Naval War Game.

To the Editor of the SCIENTIFIC AMERICAN:

I beg to congratulate you on your energy and enterprise in securing the right to publish the series of Jane's Naval War Game. You not only deserve credit for supplying your readers with such an intensely interesting subject, but you deserve credit for drawing the attention of the nation to a critical state of affairs.

It is true we may never go to war with one of the powerful European nations; but the best way to make sure of that is to have a fleet that they would dread to encounter. Owing to our late "expansion," we now need two fleets; one in the Atlantic second only to England's, and one of considerable power in the Pacific.

The "War Game" shows how greatly we would have to weaken our Atlantic fleet if an attack should be made on the Philippines—and there is where it would be made—as far as possible from our home base of supplies.

If civilians are allowed to join the new Naval League I would like to have the honor of becoming a member. Can you kindly give me any information about that? I have been looking for some professional criticism of the "Battle of Manila." There seem to be some lessons of great importance in that engagement; though I think the Americans were not given credit enough for gun fire and probable skill in action. One of the lessons is—modernize the "Oregon" class by substituting 12-inch guns for the 13-inch, lowering the 8-inch turrets so the guns can fire on a line with the keel, and using the weight saved by adding more 6-inch guns. All 13-inch guns ought to be replaced by 12-inch. Some "semi-battleships" carrying two or four 10-inch guns and not less than twenty 6-inch guns would make a welcome addition to meet such vessels as the "Kaiser" class. B. D. MERCHANT.

San Jose, Cal., March 5, 1903.

Safety of Railway Travel in England.

To the Editor of the SCIENTIFIC AMERICAN:

The awful accidents which one hears of almost daily in this country would be comparatively few if the railroads were operated on the same basis as those of England. There is not a railway in England that is not fitted out with a complete block signaling system, which is worked by an army of trained men, most of whom enter the railway service as boys at fifteen and sixteen years of age, and usually start in the signal boxes or cabins as telegraph learners. They serve two, three, and even four years, until they are thoroughly acquainted with the telegraph instrument and the working of the signal box, when they are drafted out as relieving signalmen, and are appointed signalmen whenever a vacancy arises. A man when once appointed to a box usually holds the same position for quite a number of years, so that he is able to get thoroughly conversant with everything around him. He has to have good eyesight and hearing, being examined for this about every two years. The signals and points mostly all work together by means of an interlocking arrangement, so that when the switch or point is pulled the signal is pulled at the same time. Nearly every country station has its signal cabin or box with signalmen always on duty. These usually have twelve-hour shifts, but in busy yards they work on eight-hour shifts. On single-line roads, or what are termed "branch lines," they work by what is called the "train tablet system." With this system it is impossible for two trains to be at the same time in one section. The train tablet is worked by an electrical arrangement from one signal box to the other, and the enginemen of the trains before starting on their journeys on a single road are compelled, under penalty of instant dismissal, to see that they have the train tablet handed to them by a responsible person and fixed in a secure position on the footplate, where they can see it. When they reach the next section they have to deliver one tablet and receive another. Trains running in an opposite direction they pass at stations booked in their time table book, or, if trains are running late, arrangements are made accordingly; so that under this system it is almost impossible for a collision to occur. In nearly every branch of the railway service a man has to start at the bottom and be trained up to the more responsible positions; but at busy times when traffic is heavy, most railways employ supernumeraries to do less important duties. The hours of enginemen and firemen are not to exceed ten to twelve hours on duty, so that there is no chance of their being overworked. The officers of the various departments have to draw up weekly reports of hours worked by railway servants and these are sent in to the Board of Trade authorities.

Now as to the keeping up of the roadbeds, bridges, culverts, etc. There are district engineers appointed for so many miles of road, which is divided up into so many sections. Each section is kept in good working order by five men, the foreman, platelayer or "ganger," as he is termed, and four men to work under him. One of the ganger's most important duties is to traverse the entire length of his section every day to see that everything is all right and to report any serious defect in the road or bridges, etc., to his district engineer, who then informs the heads of the various departments, who issue out printed forms to all persons concerned, so that they can be on the lookout and be prepared to stop if required to do so. On nearly every railway there is a man to about every mile of road, so that it gives them a good chance to keep the road in thorough repair. Should a collision or railway accident of any kind occur, there is a Board of Trade investigation, presided over by Major Marinden or Colonel York, to determine the cause and the persons responsible for it. The very few accidents that take place around London, where the traffic is so thick, especially at Waterloo Station, during the Derby, Ascot, and Kempton Park race days, when trains are arriving and departing every minute or so, is truly remarkable, particularly since London is subject to heavy fogs. These, however, they are always prepared for, by having the platelayers do their part as ground signalmen to lay the detonators or torpedoes when required, so as to warn enginemen when they cannot see the signals, etc.

Now as to the important duties of the enginemen. The engineer is supposed to keep a strict lookout for all signals, and the fireman is to assist him in doing the same when not engaged in firing up or putting water in the boiler, etc. The rules require firemen to do these duties as far as possible between stations, especially on express trains, and to be on the lookout for signals on approaching stations and junctions, so that if the engineer did not catch sight of the signals the fireman would, especially when traveling by night. Then again there are issued, every three months, time table books for the drivers and firemen. At the head of each leaf of the book the following is printed: "Time must not be made up in running down inclines, and the men are supposed not to take any chances whatever." When an engineman is leaving a station with his train he is supposed to look back and see that the entire train is following and be prepared to stop if signaled to do so. All these things go toward making the safety of the traveling public complete as shown by the fact that not a single life was lost on British roads last year. ALFRED T. LANCASHIRE.

Little Valley, N. Y., March 7, 1903.

A Coal Substitute.

To the Editor of the SCIENTIFIC AMERICAN:

As a coal famine is subject to occur in the future, possibly the following regarding cheap fuel might be of use to the public in districts where the material is found to exist.

While living in South Wales we used to send to a neighboring pit for a horse load of slack coal, costing 60 cents. This we mixed with two-thirds clay (dug up near the house) in the form of mortar, and then turned it out by hand into balls three or four inches in diameter. These, when dry or nearly so, we placed on already started coal fires for heating rooms, coal at the time being extremely cheap and handier for cooking. They became like balls of red-hot iron, giving out great heat and lasting about twenty-four hours, when they crumbled to ashes. The fire was renewed by placing more on top and making a fuel, as may be seen, costing only 20 cents the ton.

Now it occurs to me this peculiar clay (no doubt some vegetable substance) must exist in many parts of the North American continent, probably in large quantities, possibly beneath the entire prairies, among mountains, beneath some kind of swamps, and overlying coal fields. Also that it can be made to burn by a mixture with some other material, such as sawdust, peat, or finely chopped straw or cornstalks.

For those living inconvenient distances from coal mines or wanting cheap fuel, I would suggest experimenting with any kind of clay they think might have these properties. It will cost little time or trouble. It would be easy for the government to import one or two hundred pounds from the same spot for analysis. To any one communicating direct I will give such further information as lies in my power.

HENRY TAYLOR.

Chaworth, London South, Ontario, February 14, 1903.

The Designing of the "Connecticut."

To the Editor of the SCIENTIFIC AMERICAN:

In view of the fact that the General Board of the Navy has unanimously advised Congress to have our future battleships follow the lines of the "Connecticut" class, it would be interesting to examine this design and see if advantageous changes are possible. The design for the "Connecticut" is probably the finest piece of work of its kind that has ever been turned out here or abroad and the action of the English Admiralty in discarding completely their own previous designs, and practically copying the "Connecticut" for their latest and largest battleships, is a great compliment to our designers.

In looking first at the armament of this battleship, it shows up both enormously powerful and excellently proportioned; nevertheless it looks like a mistake to reduce the length of her 8-inch guns from 45 to 40 calibers, and 100 rounds per 7-inch rapid-fire gun does not seem sufficient.

The writer thinks that these two items should be changed, even if it should be necessary to omit two or even four of the 3-inch guns and their ammunition supply. This could be done without materially impairing the fighting efficiency.

In regard to the protection, the results do not appear to be quite so satisfactory. The larger part of the side is covered with 6-inch armor only; and in view of the fact that foreign navies are increasing the sizes of their broadside guns, and that the thickness of the casemate armor on the latest designs in England is 9 inches and 7 inches, this is too light.

It would be possible, by slightly modifying the plans, to carry a casemate belt of 7½-inch uniform thickness extending from the main belt to the main deck, with athwartship armor of the same thickness by proceeding as follows:

Stop the lower casemate belt at the same point that the upper stops at now, and carry the lower athwartship armor across to meet the barbettes just under the upper. This will result in a saving in length of both the lower casemate and lower athwartship belt, and on one side of the ship would amount to about 545 square feet of 6-inch armor, equivalent to 3,275 square feet of 1-inch armor.

Next dispense entirely with the 2-inch nickel steel protection to the 3-inch guns; battle experience having shown this class of armor to be dangerous, it not being sufficiently thick to exclude common shell from guns of 6 inches and above, and would only serve to make the explosion of such shells more disastrous. This would save about 700 square feet of 2-inch armor or 1,400 square feet of 1-inch, making a total saving of 4,675 square feet of 1-inch armor.

To increase the thickness of the casemate and athwartship belts to a uniform 7½ inches, would require about 2,420 square feet of 1½-inch armor and 1,630 square feet of ½ inch, equivalent to 4,450 square feet of 1-inch armor.

This process would leave a margin of 225 square feet of 1-inch armor for each broadside, and for the whole ship would save about 8 tons in weight.

The barbettes would have to be changed to meet the above conditions, making the face outside of the 7½-inch armor 10 inches thick, and the portion inside 6 inches thick.

This would involve a very slight increase in weight, which could be deducted from the surplus 8 tons.

The proposed changes would lower the position of the center of gravity of the masses involved about 5 feet, and would apparently add to the efficiency of the ship.

Note.—The above discussion is based on the plans submitted by Admiral Bowles to the Society of Naval Architects and Marine Engineers at their last annual meeting. G. B. M.

677 Washington Street, W., Bath, Me., March 2, 1903.

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A CURIOUS ELLIPTICAL BRIDGE.

A clever and peculiar example of bridge construction and erection has recently been carried out upon the seacoast of County Antrim in the North of Ireland. At this point the shore drops precipitously into the sea, the cliffs known as "Gobans' Cliffs," which tower to a height of 200 or 300 feet, being of the basaltic origin seen in this part of the country.

This seacoast scenery is of the wildest and withal most beautiful in its solemn grandeur in the North of Ireland; and to enable visitors and tourists to view the spectacle from its most advantageous points, and also to gain access to the many remarkable caves in the vicinity, a walk has been cut out and built in the face of the cliffs, which in itself constitutes a commendable engineering achievement. This pathway is only from two to three feet in width, and winds along the face and climbs the cliffs in a most extraordinary manner, which from a short distance always imparts to the promenade a most perilous appearance, since immediately below, the waves thunder among the rocks. But the walk has been most skillfully and cleverly designed and constructed. Steps are cut roughly and broadly into the solid rock, but to insure perfect safety to climbers a handrail has been provided. The intervals between the rocks are spanned by delicate and spider-looking bridges of iron. The length of the walk so far constructed is nearly three miles, and it is to be continued for another two miles, which it is anticipated will be completed within a few months. The work is being carried out by the Belfast and Northern Counties Railroad under the supervision of Mr. Berkeley Wise, the chief engineer to the railroad.

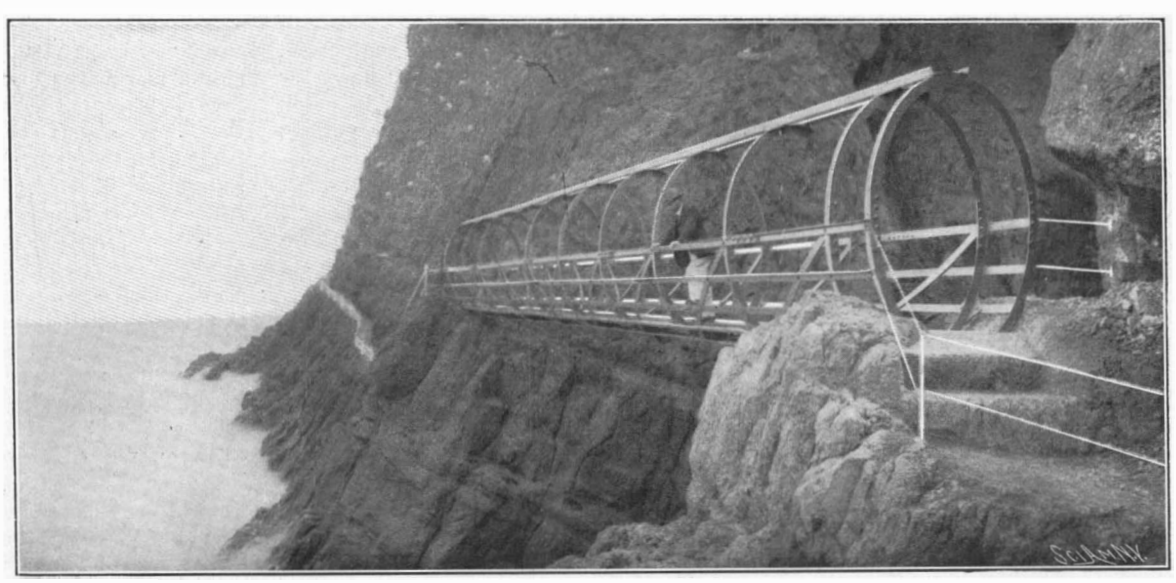
The most notable triumph of engineering in connection with this work is the erection of what is known as Gobans' Bridge. This structure is distinctive owing to its curious design, being elliptical in shape. This piece of work was rendered necessary to span a gap 65 feet in width, giving access from the mainland to an isolated rock known as "The Man-of-War."

The general shape of the ellipses of the bridge and its method of construction may be comprehensively gathered from our illustrations. The bridge has a clear span of 65 feet, but is 70 feet in length from end to end. The main structure of the bridge consists of twelve ellipses made of steel placed equidistant. The major axis of each elliptical section is 7 feet inside, with a minor inside axis of 4 feet 8 inches. As will be seen from our illustrations, each of the ellipses is made in two segments of 3-inch by 3-inch by ⅜-inch angles. They are spaced 7 feet 3 inches centers, except the end ones, which are 2 feet 4½ inches centers. The ellipses are held firmly in position by means of longitudinal iron bars, attached to the ellipses by means of stiffening plates 10 inches by 10 inches by ⅜-inch. The longitudinal members are angles 3 inches by 3 inches by ⅜-inch, and the flat bars are 3 inches by ½ inch. The ellipses are additionally strengthened by means of diagonal stays or bracings extending from the points where the half sections of the ellipses are joined.

This arrangement yields a stronger foundation to that portion of the ellipse which is to carry the greatest weight, i. e., the floor. The diagonal lattice steel girders are 3 inches by ½ inch, and carriers for floor angles 3 inches by 3 inches by ⅜ inch. The flooring of the bridge comprises two pieces of pitch pine 12 inches in width by 3 inches in thickness, laid upon the interior bottom surface of the ellipse and raised sufficiently therefrom to afford a perfectly flat surface upon which to walk. In the cross section therefore the internal major axis from the floor to the crown of the ellipse is sufficient to afford a clear walking space to accommodate the tallest persons.

Owing to the exposed position of the site of the bridge, the turbulency of the surf playing upon the rocks immediately below, and the strength of the tides, it was found impossible to erect the bridge on the spot. Under these circumstances the structure was erected at Belfast and transferred intact to a scow. The latter was then towed to "The Man-of War" rock and carefully brought to, as far as possible, immediately below the spot where it was to be installed. Lifting tackle was then placed in position upon each side of the gap to be spanned at the roadway level, and the lifting cables attached to each end of the bridge. The hoisting operation had to be carried out with extreme care, owing to the cramped space in which the lifting tackle was operated, and to prevent the structure being thrown by its own swinging motion when suspended in the air against the face of the rocks, which would have seriously damaged it. The structure was, however, lifted to its position without mishap. It was originally intended to stay the bridge when in position with guys, but when the bridge was erected it was found to be sufficiently rigid to dispense with these additional supports. The bridge was designed by Mr. Berkeley Wise, the chief engineer to the Belfast and Northern Counties Railroad of Ireland.

PECULIAR BRIDGE CONSTRUCTION ON THE NORTH COAST OF IRELAND.



GENERAL VIEW SHOWING THE POSITION OF THE BRIDGE ON THE CLIFFS.

Railroad building by electric light is the experiment about to be tried by the Santa Fe Railroad Company, when it begins the construction of its cut-off line which will connect the Pecos Valley line with its main line in New Mexico. A large electrical plant will be installed at the mouth of the Abo Pass Canyon, and six hundred laborers will be kept at work all the time.

Profits of Irrigation in the Eastern Part of the United States.

The rise in prices of agricultural lands in the last few years has made it necessary that farmers should get the largest possible return from their lands, and has created a general interest in whatever will help to that end. One of the aids now being considered is irrigation. In the East it is not, as in the West, absolutely necessary for the raising of any crops, but, like fertilizing or thorough cultivation, is a means of increasing the returns from land. The whole question is whether it will pay. The report of the irrigation investigations of the Department of Agriculture for the year 1901, carried on under the direction of Elwood Mead, gives some valuable data on this question. The report covers experiments in Missouri, Wisconsin, and New Jersey.

A series of experiments extending over several years at the Wisconsin Experiment Station at Madison shows a marked increase in the yields of farm crops. The average increase in the yield of clover hay on irrigated land over that from unirrigated land has been 2.5 tons per acre; the average increase in yield of corn has been 26.95 bushels per acre; and potatoes show a gain of 83.9 bushels per acre. The annual cost of irrigation at Madison has been $6.68 per acre, not including any interest on the investment, but including all extra labor. At current prices, this leaves a net profit from irrigation of about $20 per acre on hay, $11 per acre on corn, and $73 per acre on potatoes. The conditions of soil and climate at Madison do not differ from those of the Middle West generally, and the results given above show that where water can be obtained without too large an outlay irrigation as a part of intensive farming is very profitable.

Another series of experiments was begun for testing the effect of irrigation and fertilization on sandy soils, such as are common in large sections of Michigan, Wisconsin, and Minnesota. These lands are poor in plant food, and retain so little moisture that all attempts to farm them have failed. The experiments included the supplying of both manure and water. Manure alone was of little use, as there was not water enough to make the plant food available. Water alone produced good results, but the application of both gave the best results. The cost of irrigation was $6.70 per acre, and the net gain from irrigation was as follows: Potatoes, $30 per acre; corn, $1 per acre; watermelons, $58 per acre; muskmelons, $45 per acre. From these experiments it seems that with special crops irrigation of the sandy lands is profitable, but the increase in yield of corn is not enough to justify the expense of securing a water supply.

In New Jersey water has been used on small fruits and vegetables, and the added returns due to irrigation vary a great deal with the seasons. Some years no irrigation is needed, in others all crops need it, but in most years some crops are helped by it. Prof. Voorhees, who has charge of this work, reports that in his opinion, irrigation where tried has paid well. Pumping from streams or wells is the most common way of getting water for fruit and garden irrigation. Small plants furnishing water enough for from five to ten acres, including pump and engine, cost from $200 to $500.

Farmers around Butte, Mont., have organized to make a fight against the owners of the ore smelters in that vicinity, which, it is claimed, have ruined the agricultural industry of that section. The statement is made by the farmers that no less than five tons of sulphuric acid and half that amount of arsenic are discharged into the air daily, and that the crops for a great many miles around are affected.

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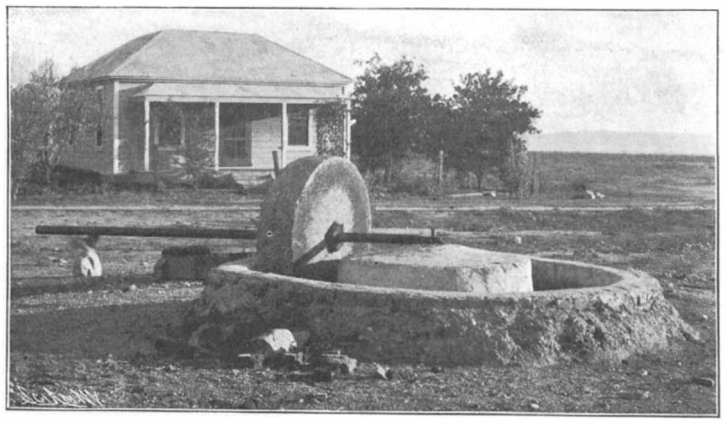
WHERE OLIVES GROW.

BY CHARLES F. HOLDER.

In the wide valley of San Fernando, down by the crumbling mission of San Diego, or in the shadow of the picturesque pile of Santa Barbara, the stroller finds some of the oldest olive groves in California. They were planted by the old padres, inspired by the old and true Italian proverb, "An olive orchard is a gold mine on the face of the earth. He who plants an olive orchard plants for the centuries a perpetual income." Whether it is the associations or the charm of the climate, that is one of eternal summer so far as real winter is concerned, there is a fascination about the olive fruit and tree that induces many to attempt its culture aside from the merely commercial reasons. We see the old grove at San Diego from the mesa on which stands the fast-crumbling mission. It lies in the valley against low hills through which arroyos have broken. Along this old King's Highway are some of the oldest date palms in America, and among them is a modern windmill startling in its incongruity.

There is something particularly attractive about the olive tree; its very shape tells of thrift; its upright growth, graceful and pointed leaves, olive-hued now, but turned by the gentle wind, glisten like silver. It is generally supposed that the home of the tree was in Italy, where it has been known for ages, and where the growth is so slow that it is a common saying that a man plants olives for his grandchildren; but on the foothills near Elizabeth Lake a wild olive has been found, a large and thrifty tree. It appealed to the early Californians because it came into early bearing and practically never died. The old trees of San Fernando, which have been deserted and neglected for seventy-five years, are now being cared for, and are rapidly throwing out branches and assuming their normal shape and beauty, and bid fair to equal the famous trees of Europe and Asia, which have been bearing fruit for one thousand years.

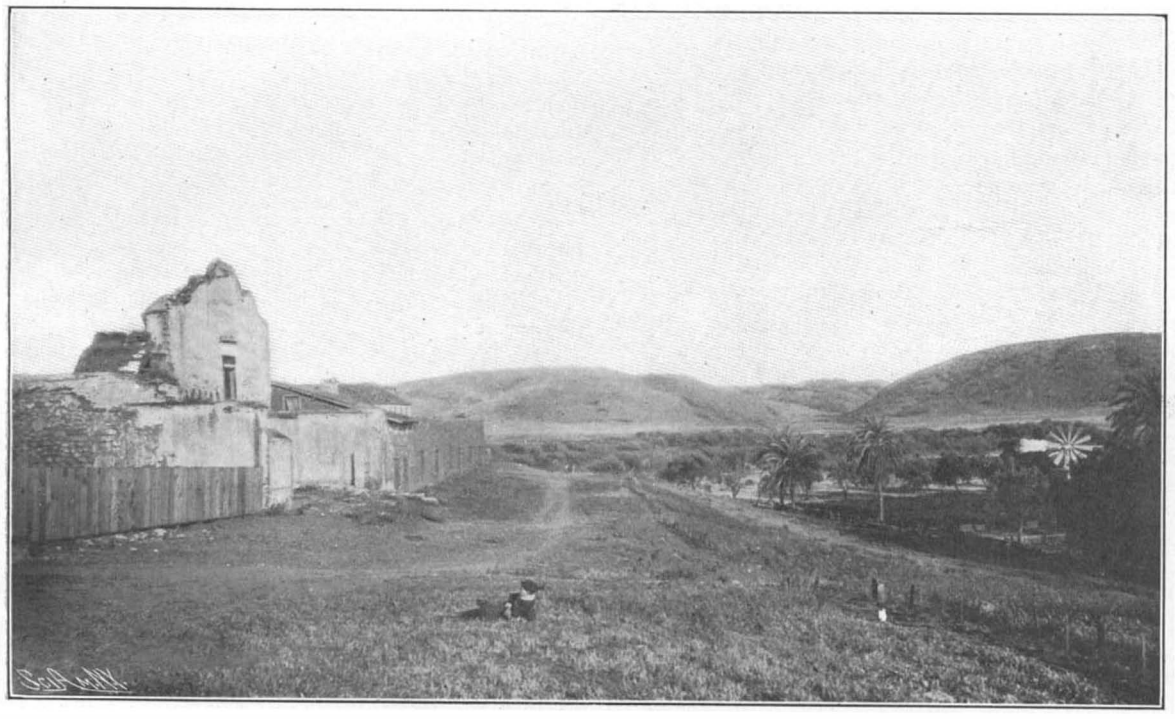
The enthusiast, if he is the man to succeed, does not come to California to sit in the sun and watch things grow, but comes prepared to concentrate all his intelligence upon the work in hand. The successful culture of the olive, or any other fruit, in California requires intelligence and work as elsewhere, despite the fact that nature invites, indeed urges, one to rest by the wayside.



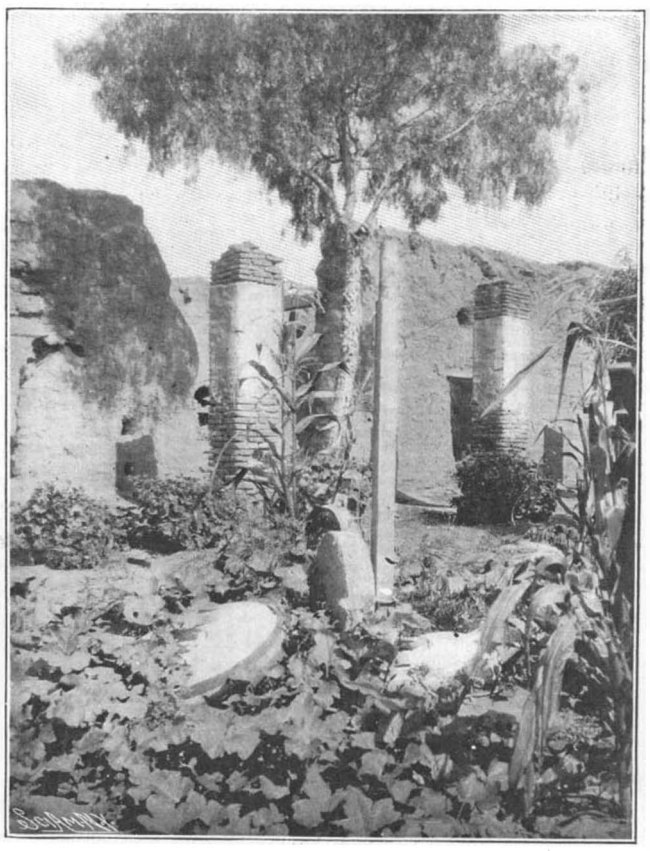
AN OLD MILL AT SAN FRANCISCO.

It is the land of *dolce far niente*, but not to the successful orchardist; he must be a man of vigor and energy and eternal vigilance his watchword. Having secured his land, he buys from some reliable dealer cuttings taken from good, sound trees. These are three-fourths of an inch in diameter and two-thirds of a foot in length—slender material one might think from which to produce a bearing tree in four years. These cuttings have been taken from the parent tree in December or January, and are planted in rows in sandy soil, being replanted permanently in February and March at a distance of about twenty feet apart. These will grow readily, and for a year the ground is kept well turned, the bush then being trimmed into a tree by cutting all the shoots but one, and in succeeding years the grower watches the tree and prunes it, with the idea in view of making a lusty tree. In four years some berries will be obtained, and the orchardist is delighted at the luxuriant growth and the rich green olives, which hang so gracefully, but yet not sufficiently abundant to be of commercial value. In the sixth year the trees should produce thirty gallons each, and in eight years the grower finds himself in possession of a beautiful and productive grove. The trees have grown so wide that they fill the entire space and meet, and each tree under the most favorable conditions should produce forty gallons of olives. The orchardist figures that with one hundred trees to an acre, and forty gallons per tree, he will have four thousand gallons; but there are pests and other enemies which materially reduce this estimate. Indeed, if the grove produces a fourth of this, he is doing well.

In November, when the first rains come, the olives ripen, and as soon as the berries begin to turn purple the picking begins; and if five hundred acres have been planted and are in bearing, a gang of Mexicans

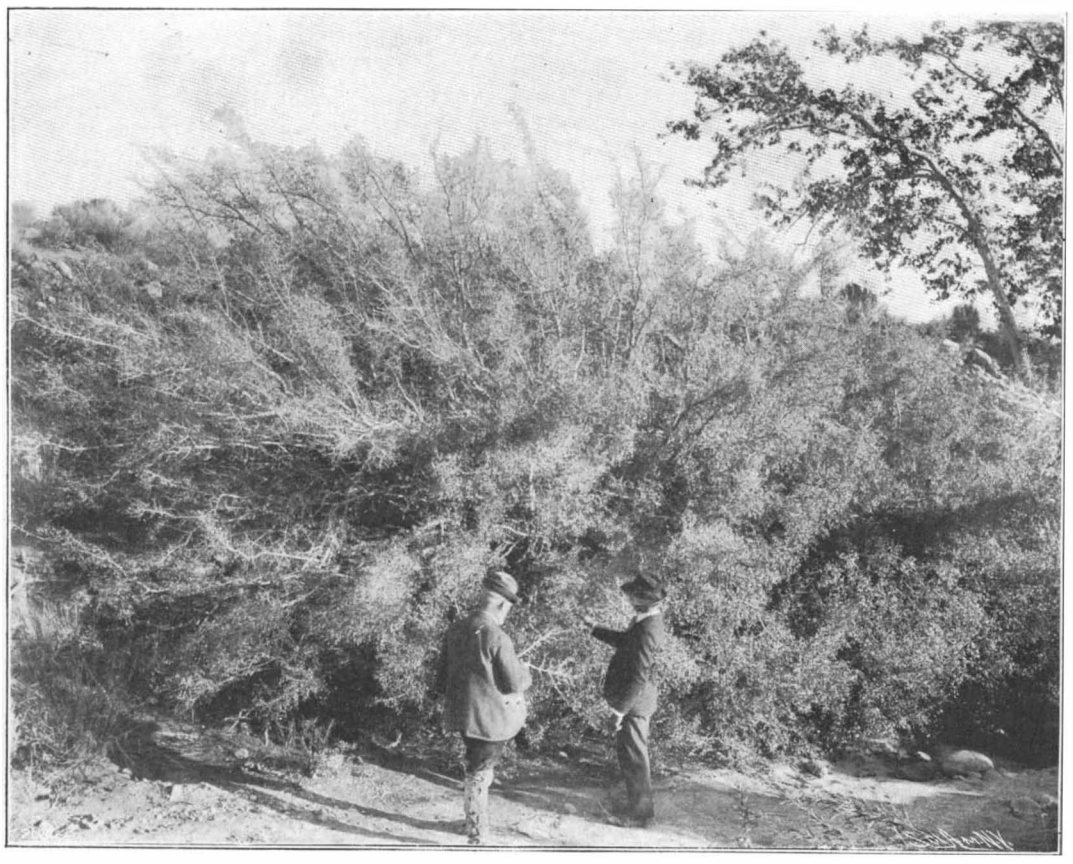


SAN DIEGO MISSION WITH OLIVE ORCHARD AND DATE PALMS.



THE OLD OLIVE MILL AT SAN JUAN CAPISTRANO.

CALIFORNIA OLIVES.



WILD OLIVE TREES AT LANCASTER, CAL.

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and others may be seen on the ground. Each picker carries a canvas open bag suspended in front of him, about the neck, and a good picker should pick four hundred pounds per day. Some use ladders; others pick from platforms on the wagons which are driven along. After the picking the olives are subjected to a drying or evaporating process, and now the orchardist is confronted with the most delicate part of his work, the making of olive oil. In the olden days the crusher or mill was a conspicuous feature of every mission, and that of San Fernando is still in good condition, while the ruin of the old mill of San Gabriel is one of the points of interest in the San Gabriel Valley. The temperature of the drier is not over 130 deg., and so arranged that the work is completed in two days. The drier itself has a capacity equal to the production of the grove, that of one orchard being 500 square feet of surface, and holding about 2,000 pounds of olives; five pickers at 400 pounds a day keep it filled. The crusher is interesting. It resembles a millstone, but rests on its edge, which is six inches broad and runs in a circular trough six feet across, made of cement. Its axis is a long pole which is fastened to the center of the trough, at the opposite end of which is harnessed a horse, the motive power; in the old days several Indians performed the work.

In such a mill, seemingly small for the purpose, the product of an orchard of one thousand trees can be crushed. The millstones differ in size, and in large orchards there are several. A building is generally erected over the crusher, and the horse works outside of it, as everything about the olive is kept as clean as possible. The olive pulp is taken from the crusher and massed in lumps or cakes about three feet square and three inches thick. The press resembles a New England cider press, and two are required to press out one hundred gallons of oil a day. The entire process is interesting. The result from the press is run into tanks, where it remains for three months, the oil rising to the surface, where it is readily recovered. The seemingly dry pomace or residuum in the press is put through a second crushing and treated to a bath of hot water, by which a large quantity of second-quality oil is produced, even a third quality being made. The oil now obtained goes to the clarifier or filter, which is a series of boxes from five to seven in number, the bottom covered with fine cotton batting. Some use a series of metal boxes, one in the other, each having a wire sieve bottom, the oil dripping from one to the other, and coming out pure and as beautiful as liquid amber. The majority of foreign or imported oils are adulterated and made up of cottonseed or hog's lard. The extent to which this is carried may be realized from the fact that the cottonseed exportations from New Orleans for this purpose in one year were sufficient to fill fifteen million oil bottles at a cost of ten cents per bottle.

The orchardist probably pickles and bottles a portion of his crop, and in California there is an ever-increasing demand for the ripe olive, which when cured is very dark and rich. In pickling, the olives are first placed in fresh water, which is changed daily for forty or fifty days, after which they are placed in salt brine to be changed several times, and finally placed in a brine the water of which has been boiled, and there are many variations from this which result in the attractive olive of commerce. The orchardist now has a fine producing grove, but his paths are not all *coleur de rose*, as while the olive can be said to be freer from pests than many other trees, yet success is only attained at the price of eternal vigilance. Nature is capricious, and does not always produce conditions perfectly favorable. A year of intense heat may come just at the wrong time, or a cold snap may literally nip the year's prospects in the bud, and early in his experience the orchardist is confronted with an army of pests which he must fight day and night. How discouraging this is at times can be realized by a glance at the authorities on the olive scale insect, by whom we are told that one female will produce four thousand eggs, and that a single coccus will produce five generations, nearly six billion descendants; or at the end of a year, according to Lejourdan, the progeny of a single female will be one billion billion. This is appalling, yet the world's supply of olive oil is kept up, and the pure oil of California leads in quality and return.

A new floating pontoon dock is being constructed in Great Britain for Durban, South Africa, to replace the one which was recently wrecked on the rocks off the coast of Cape Colony, while *en route* from England to its destination. This new dock is to be much more powerful than the one which was wrecked, though it will be similar in construction. It will measure 475 feet over all—an increase of 110 feet over the wrecked dock—while its lifting capacity will be 4,000 tons greater—8,500 tons as compared with 4,500 tons.

Engineering Notes.

The Pennsylvania Railroad has a contract to take all the cars which can be turned out by the Pressed Steel Car Company, between December 1, 1902, and June 1, 1903. The capacity of this plant is one hundred cars per day. This means an expenditure of $15,000,000, and will increase the capacity of the Pennsylvania equipment by about 750,000 tons.

After having been extensively overhauled and renoated, the Hicks Locomotive and Car Works at Chicago Heights, Ill., is now in full operation. The improvements consisted of replacing all the original buildings with a single exception with fine well-lighted and ventilated buildings. This concern is devoted almost exclusively to the repairing and rebuilding of heavy and modern locomotives. The capacity of the works is at present 15 locomotives, 15 coaches and 200 freight cars per month. Thirty locomotives can be handled at one time at the Hicks plant.

In connection with the speed trials of the new British cruiser "Drake," in which a speed of twenty-four knots was obtained while running at full speed, experiments were carried out with a new type of propeller, the blades of which are almost circular in shape, instead of the present approach to the oval form. By this arrangement the screws obtain a more powerful grip of the water. Owing to the conspicuous success which attended the speed trials of the "Drake," since the maximum speed contracted for was only twenty-three knots, it is proposed to carry out further tests with the propeller upon other vessels.

The Pennsylvania Railroad has been experimenting with a new style of track, which has been laid for the purpose of making a practical test on the Fort Wayne Division, at Leetsdale, Pa. The tracks are laid on a pressed-steel girder of trough shape, and directly supporting each rail with channel spacers to maintain the gage and fastenings for the rail, which do not require the use of bolts, wedges, or any other movable parts. This constitutes the rail in its entirety, and although simple in construction, is effective in providing a solid track without the use of heavy ballast, as is required by the wooden ties.

The commission appointed by the French Admiralty to investigate the subject of water-tube boilers, to ascertain the best all-round boiler of this type for naval vessels, and to investigate the respective advantages of small-tube and large-tube boilers, has published its report. The commission recommend the adoption solely of large tubes for boilers fitted to battleships and armored cruisers. Experience has conclusively proved to the commission that the small-tube boiler, while it gives a higher evaporation per square foot of heating surface than the large-tube boiler, consumes far more fuel per unit of power, while it is also more difficult to clean and repair the tubes. In this decision the commission is supported by the results of the boilers of the "Jeanne d'Arc" and two other similar vessels. Two types of boilers —the Niclausse and the Belleville—are advocated as being the most satisfactory water tubes, though in the case of the Belleville, economizers are deprecated. Either of these two types will be fitted in all future vessels, including those now under construction. It has furthermore been decided that in the full-power and subsequent trials with only 75 per cent of the boilers in use, of vessels, the maximum fuel consumption is to be 22½ pounds of coal and 30¾ pounds per square foot of grate per hour respectively.

The Current Supplement.

The current Supplement, No. 1420, contains a noteworthy series of articles on widely different topics. The salmon investigations of the steamer "Albatross" in Alaska are fully narrated by Commander Jefferson F. Moser, and are illustrated by many striking pictures. Fred T. Jane presents another installment of the Naval War Game between the United States and Germany. In the present installment he tells of the severe defeat and destruction of the German fleet in the Far East. Emile Guarini gives an account of a very novel way of solving the smoke problem. The article describes the method by which the smoke is not consumed, but is commercially utilized in the form of an enriched gas. J. D. Geddes writes on photography as applied to illustration and printing. Charles C. Drueding presents a plain, intelligent treatise on chamois skins. Ceylon tea is now almost as widely consumed as the tea of China and Japan. An article on the tea industry of Ceylon will, therefore, not be without interest. Prof. Asaph Hall, president of the American Association for the Advancement of Science, distinguished the world over for his astronomical work, presents a scholarly paper on the science of astronomy. Prof. Wesley Mills, of McGill University, for a number of years has studied the behavior of animals totally blind in either one or both eyes. He summarizes his studies in an instructive review. The paper on high temperature electro-chemistry by R. S. Hutton and J. E. Petavel is continued.

Electrical Notes.

A patent has just been issued in the United States to Mr. I. M. Hunter for a coin-controlled X-ray machine for public use. The external appearance of the apparatus is similar to that of the automatic cinematograph machines so commonly seen on railway platforms and other places. The observer places a coin in the slot, moves a lever, puts his hand, or whatever he wishes to examine, into a box without any sides, and looks down at it through a fluorescent screen which forms the top of the box. The coin, on being inserted, closes the primary circuit of an induction coil worked by a few dry cells, and the vacuum tube is in a position immediately below the object to be observed.

A novel way to get electricity for lighting a railway train is described by Cassier's Magazine. A dynamo is located on the engine, perhaps under the pilot. Power in driving it is derived from a rotary fan or windmill immediately above, under the headlight. As the locomotive travels at the rate of 20, 30, and even 40 miles an hour, a breeze of corresponding velocity is developed. The current is conveyed to small accumulators under each car of the train. It may be assumed that when these are fully charged, the current is automatically cut off. Tests are said to have been made with an outfit of this kind, and the results are said also to have been encouraging, contrary to what one might be led to expect.

A short time ago the proposal was made and seriously entertained in some quarters to distribute Greenwich time to vessels at sea as well as inland by wireless telegraphy, and, according to our contemporary, Cosmos, Messrs. Burgos, a firm of clockmakers at Ocejos, have devised an apparatus for carrying out the distribution inland. A standard or primary clock determines the discharge of an oscillator at regular intervals. The local or secondary clocks have each an air wire to direct the electric waves on to a detector, which actuates a mechanism and corrects the hands on the dials. We are not aware that the above plan has been put into practice yet, nor is information available as to the results of experiments. The difficulty appears to be that other signals by wireless telegraphy will affect the clocks.

An automatic mechanism which is intended to register the number and class of passengers of a car, the distance ridden by each, the approximate time and place of ingress and egress of each, identifying the conductor, car, trip, day or night, noting the hour or minute of the day or night and the approximate location of the car, in order to obtain a true automatic register or record of the trip and the number of passengers carried independently of the co-operation and beyond the control of the conductor, is an invention for which Frederick W. Brooks of Brooklyn, N. Y., has obtained a patent. The apparatus takes its records in such a manner that they may be used as lantern slides and projected on a screen. An automatic mechanism controls electric circuits and connections to operate a camera electrically, at such intervals or distances apart as may be desired by and in consequence of the revolution of the car wheels. The mechanism is arranged in such a manner that the intervals can be changed or adjusted at will. The camera is so adjusted as to photograph the interior or part of the interior of the car, the platform or platforms and side running boards, and any and all passengers that may come within its field. The camera is so connected with the electrical appliances of the car as to cut off objectionable or conflicting lights. The connections are all protected. The parts of the invention may be briefly summed up as follows: First, a device connected with and operated by the revolution of a wheel or axle of the car and an electrical connection by which the operations of the camera and registers and the distance between such operations are actuated and controlled; second, an electric current from any available source, preferably a battery, either primary or storage, situated in such part of the car as may be deemed most convenient and connected by conductors with the above device, by which the circuit or circuits are opened or closed, the opening and closing of the electric currents being arranged to operate the camera or cameras, the registers, and the lighting and de-lighting of the car; third, a method for automatically lighting the car in such portions as are desired and means for shutting off conflicting or objectionable lights.

A Correction.

In the Scientific American for February 14, there appears an article under the heading "Transporting Lumber Across Deep Gorges," in which credit for the design of the installation described is given to Mr. Edward I. Parsons. We are informed that the system in question was really designed by Percy R. Stuart, of San Francisco, Cal., and we take this opportunity of giving to him the credit to which he is properly entitled.

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CURIOUS JADE CARVINGS FROM MEXICO.

BY WALTER L. BEASLEY.

The Mexican Hall of the Museum of Natural History, through original researches and explorations of Prof. Marshall H. Saville, together with recent gifts of the Duke of Loubat, has now on exhibition the most extensive and valuable collection of jadeite objects in the world. The variety and brilliant array of the specimens in design and polish, all exquisitely carved, strikingly illustrate the style and character of the ancient ornaments worn by the kings and aboriginal inhabitants of Mexico and Central America, centuries before the coming of Cortez. One of the astonishing features disclosed by the jadeite collection is the extraordinary skill and perfection displayed in the cutting, drilling, and polishing of the hard stone, so effectively accomplished by these ancient craftsmen. The specimens vary in size from one inch upward, and were obtained mostly in the State of Oaxaca. Prof. Saville found great numbers during his recent excavations among the Zapotecan tombs and temple structures in Oaxaca, which State is now considered to have been the metropolis of the highly-gifted race who occupied this area. The capital, Monte Alban, recently excavated, contained many elaborate palaces and other monumental buildings. The donated collection of the Duke of Loubat numbers some 300 pieces in all, 100 being of pure jadeite, the remainder being of obsidian, serpentine, amazon and turquoise. The collection included several rare and beautiful specimens, among them two gems of their kind being breast ornaments, carved in the shape of a parrot and turtle out of a piece of apple-green jadeite, the most highly prized of all colors. Another interesting carving is in the shape of a highly-polished hatchet, of pure jadeite, only a few of which have yet been found. It is supposed that the hatchet was not intended for practical service, but that it was worn symbolically as a decoration. The body of the extensive collection is composed of breast, ear, and lip ornaments, necklaces of beads, and idols.

The majority of the specimens are profusely sculptured in high relief, the face sometimes in full and in profile, with huge earrings, while in most cases the head is surmounted with the characteristic plumed headdress, like those represented on the ruined structures of Central America. The hat-shaped ear ornaments are nearly two and a half inches in diameter, and are pierced through, leaving thin rims and walls designed supposedly to hold the clusters of feathers which were used in the head-ornaments of that age. The most noteworthy and remarkable piece of jadeite in the collection is a magnificent votive adz, the largest carved specimen of its kind contained in a museum. No other of like dimensions, ornamentation, and archæological interest exists in any of the European museums. All the salient features of this extraordinary relic, notwithstanding its centuries of burial, are still fresh and vivid to the eye of the onlooker. This was found in the State of Oaxaca. In deciphering the figure, Prof. Saville has found a series of markings which make a unit of the whole design; and, from the presence of sharp canine teeth, it is intended to represent a tiger's mask, which was a characteristic feature of Southern Mexican art. On the edge are what appear to be teeth, evidently intended to symbolize the biting or cutting nature of this part of the adz. From the enormous size, weight, and symbolism, it is thought that the adz was used as an idol, or for some ceremonial purpose. The color is light grayish-green, with a tinge of blue, and streaks of almost emerald green in the back. It is 11 inches long by 6 inches wide, and weighs over 19 pounds Troy weight. A portion weighing 2 pounds has been removed for some cause from the back. Dull markings under each eye, ear, and hand evidently were for the purpose of holding plates or rims of gold, which the polished surface would not. The polish on the adz is as fine as that of modern times. Jadeite was the most highly prized and sacred stone of the ancient peoples of Mexico and Central America, and was supposed to possess great curative properties. The word jade is thought to be a corruption of the Spanish "Ijada," the Nahuatl or Mexican name being Chalchihuitl, meaning a stone of metallic green, like the plumes of the Quetzal. Spanish historians tell us that, when a great dignitary died, one of the important mortuary customs was the putting in the mouth of the dead a stone of jadeite, which they placed as a heart. The natives and poorer classes wore them fastened around their arms and throats as charms to ward off evil and certain diseases. There are two puzzling and extremely interesting problems which have not, as said, been solved by archæologists and other investigators of jadeite, viz., the locality where it was obtained or mined, and how the ancient lapidaries carved, drilled, and sawed this hard stone from blocks. It is certain that an enormous amount of skill and time was employed in their production. The blade of a modern steel knife will hardly produce an impression on the polished surface. No drills, graving or incisive tools giving a clue to the methods of manufacturing them have as yet been found. Cortez, it is claimed by early writers, took back to Spain, among his loot and spoils, some of the rarest and best specimens in the country of jadeite. Some were especially cut and elaborately carved to order. These were presented as a gift to his wife, whose casket of jewels was said to have been the finest of any woman's in Spain. Prof. Saville, through the generosity of the Duke of Loubat, who has done more than any other modern explorer in uncovering the monuments and culture of Mexico's ancient civilization, is confident that in his future excavations and researches in the State of Oaxaca, he will undoubtedly come across the whereabouts of the long hidden jadeite mines and throw new light upon the mysterious and lost art of working this brilliant and precious stone.

CARVED JADE ORNAMENTS.

SIDE VIEW OF THE CARVED JADE VOTIVE ADZ.

FRONT VIEW OF THE CARVED JADE VOTIVE ADZ.

Fahrenheit's Thermometer.

Writing in Knowledge on the history of Fahrenheit's thermometer, Prof. Cleveland Abbe, of the United States Department of Agriculture, says: "There is every evidence that the Fahrenheit scale began with his use of plus 90 as the upper limit of the temperature of the human body, and minus 90 for the lowest temperature of the air in Europe, and also the temperature obtained by the mixture of salt and ice. Fahrenheit subsequently used a second scale in which plus 12 and minus 12 replaced the plus 90 and minus 90. In 1714, he adopted a third scale, viz., plus 24 for the temperature of the body and zero for the lowest temperature at Dantzic in 1709. His fourth scale was plus 96 for the temperature of the human body and zero for the great cold of 1709. This scale gave him 32 as the temperature of melting ice, but that natural point was not directly adopted by him. With this first satisfactory mercurial thermometer (made in 1721, and whose scale was graduated according to this last system but extended much further upward, by extrapolation) he found that the boiling point of water was constant, or nearly so, at 212 degrees. The fact that Newton's 'arithmetic scale' read 33 or 34 for boiling water, had no influence with Fahrenheit in the formation of his scale."

The Dutch Brine Vegetable Industry.

The cultivation of vegetables for pickling constitutes one of the most important industries of Holland. According to the official record, there are in all about 7,500 acres of farm land devoted to the cultivation of onions, in addition to a number of market gardens which do not enter into the official estimates. About half the entire crop is grown in the province of Zeeland, the remainder mainly in the provinces of North and South Holland. The yield per acre varies considerably with the season, but in the case of the common large onions, the average may be taken at about 300 bushels, though in some years the produce has amounted to over 370 bushels per acre. The areas upon which these onions are grown are usually small, seldom exceeding five acres in extent, and more frequently being about half that size. Small holdings are, however, a general feature of the agriculture of the Netherlands; over three-fourths of the total number of holdings consists of farms of 50 acres and under, and nearly half of this number is represented by holdings of less than 12½ acres each. The small white onions known as "silverskins" are grown mainly in the provinces of Gelderland and North Brabant, though in recent years they have also been cultivated on a small scale in South Holland and Zeeland. The total area sown with this variety does not, however, exceed 125 acres. The growers are mostly small market gardeners or peasant farmers, occupying about 2½ acres of land; a few of them rent larger plots, but their holdings seldom exceed five acres. The rent usually ranges from $17 to $25 per acre, according to the quality of the land, to which is added a rate of 50 cents to 87 cents per week for the cottage. The soil in which the onions are sown is clay, and as its surface elevation is maintained at only a little over three feet above the water level of the dikes and canals, it never gets very dry.

In cultivating silverskins the land is usually marked off into plots about 30 yards wide, separated by furrows. After having been thoroughly cleaned it is manured, then well dug over two or three times with a spade, and finally raked. No horse labor is employed. The manure is applied at the rate of 40 tons per acre. The growers usually produce their own seed by selecting from the crop in autumn the best specimens of small round silvery white onions with thin stalks and few roots. These seed onions are carefully dried aud preserved from frost through the winter (either by covering them with earth, hay, or straw, and storing in the open, or by placing them in lofts), and again planted out in the early spring in favorable situations. It is the practice to sow the seed in April, about 56 pounds per acre being used, so that the onions grow closely crowded together. This preserves the whiteness of the bulbs by saving them from too great exposure to the light. On holdings of 2½ acres little outside labor is required, as the occupier is usually able to work the land with the aid of his wife and children, large families being the rule rather than the exception among the small growers. It is the practice to put children to work on the land at 10 or 11 years of age, when they are taken away from school. Sometimes, however, and especially in cases where the area cultivated amounts to 5 acres, occasional laborers are employed to help in digging and clearing the land, and again at harvest, sufficient work being found to occupy two men for about three months in the year. But, wherever it is possible, women and children are employed, as their labor is cheaper. Children are largely employed for picking the onions. Adult male laborers earn 60 to 80 cents per day. Women are paid 50 cents, and children 25 cents a day. The average yield per acre of silverskins in Holland varies from 112 bushels, or 2½ tons, to 7 tons per acre where the seed is sown very thickly.

At a conference of German electrical engineers, Dr. Haas, of Hanover, referred to the electric power supplied for agricultural purposes in that neighborhood. The greatest demand for current is for the operation of threshing machinery, for hay presses, straw-cutters, etc. Of the total horse power installed 77 per cent represents purely agricultural operations and 8 per cent factories. On an average, the annual revenue per horse power installed amounts to 27s., at a price of 2s. 3d. per kilowatt hour, as compared with from 68s. to 146s. in towns, and the average period of use does not reach 150 hours, as against 500 hours in towns. The author concludes from the experience in the Hanover district that satisfactory results are possible in agricultural operations only where cables already exist for the transmission of power or for electric tramways.

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RECENTLY PATENTED INVENTIONS.

Agricultural Implements.

AGRICULTURAL IMPLEMENT.—D. LUBIN, New York, N. Y. Improvements are provided in this invention for implements operated by motors carried on vehicles. The mechanism is so arranged that the motor will alternately move the vehicle and operate the ground digging and pulverizing tools.

POWER-PROPELLED AGRICULTURAL IMPLEMENT.—D. LUBIN, New York, N. Y. This implement is operated by a motor carried thereon; and the object is to provide a device so arranged that while the motor is in continuous operation it will serve alternately to propel the machine and to operate the digging tool, thus making it possible to employ a motor of much less power than needed to propel the machine and operate the digger at the same time.

BARRACK-JACK.—C. HAMMOND, Woodcliff, N. J. The purpose of this improvement relates to a device for raising the roof of hay-barracks, although it may be used in other connections. In the invention is embodied an arrangement by which the jack is mounted at any height on the pole as contradistinguished from on the ground. The jack is provided with a shank with two studs which may be entered into any two contiguous holes in the post. This enables a very compact jack to be used and avoids using a long connection between the ground and the elevated roof.

BROADCAST HAND SEED-SOWER.—E. C. SMITH, St. Louis, Mo. This machine is carried conveniently on the person and operated by hand. Means are provided for securely holding the handle, for covering the seed-opening, for adjusting the gate, so as to regulate the kinds of seeds to be cast over the ground, for adjusting a gage-stop to suit the fixing of the seed-gate, and for arranging the gage-bar with the seed-plate to restrain accidental movement.

BEET-HARVESTER.—C. E. BARTLETT, Wayne, Neb. Of the several purposes of this contrivance, one is to adapt it for automatically removing beets from the ground, and means are provided for gradually withdrawing them from the soil and taking them to the rear of the machine by conveyers engaging with the beet tops. Another is to furnish cutters by which when the beets reach the rear of the machine the tops will be severed, the bodies will fall into receptacles, the final receptacle being capable of an automatic dumping action.

AGRICULTURAL IMPLEMENT.—D. LUBIN, New York, N. Y. Mr. Lubin provides an implement operated with little exertion and from the action of which all the molecules of the earth operated upon will be set in motion, the action causing a fine separation, as the particles move in all directions, leaving the ground light and porous, thus permitting aeration so essential to fine cultivation. It may be adjusted for different depths of work and operated close to plants safely.

Electrical Devices.

ELECTROMAGNETIC MOTOR.—ANGEL POL Y AGUIRRE, Havana, Cuba. This motor consists of permanent magnets secured in two non-magnetic frames, the magnetic poles of which are arranged alternately. Mounted to turn within the series of magnets at both ends thereof, are a double series of electro-magnets constituting a revoluble armature. The twin armatures assist each other in passing dead-points. Each series of electro-magnets has a collector ring connected with every second electro-magnet and a distributing ring to the remainder. Commutators and brushes connect the rings with separate mains of opposite signs.

Engineering Improvements.

PUMP.—W. H. WESTERMAN, Marietta, Ohio. The mechanism employed here relates to that class of pumps adapted to be worked by flexible power-connecting means such as is well known and commonly made use of where a series of remotely-located pumps are mechanically worked from a common source of power.

STEAM-BOILER.—E. WARD, Mayville, Wis. The part to which this improvement most particularly relates is the "arch" of a boiler. The invention provides a construction easily removed and replaced without disturbing the brick of the boiler-setting at the side or rear walls, whereby the rear end of the boiler can be exposed for cleaning and repairing. The improvement prevents expansion, which would displace brickwork, and the parts are joined so as to do away with bolts and other fasteners.

CONTROLLING DEVICE FOR HYDRAULIC CYLINDERS.—S., W., O. E., C. and H. HIBBARD, Sandyhill, N. Y. The invention relates to hydraulic cylinders for use on wood pulp grinders, and is an improvement on an invention previously filed by Messrs. Hibbard. The inventors have perfected a controlling device or valve arranged to cause inflow and outflow of water to and from the cylinder without danger of leaking and to equalize the pressure on both sides of the cylinder-piston to stop the piston whenever desired.

DEVICE FOR RAISING LIQUIDS FROM WELLS.—T. F. MORAN, De Young, Penn. Mr. Moran provides in this invention an improved device for raising oil and water from deep wells, more particularly oil-wells. The device is so arranged as to prevent the escape of the natural gas, utilizing its pressure in raising the oil to the surface. This pressure is assisted by compressed air pumped into the well.

Mechanical Devices.

MARKING-MACHINE.—C. S. MCGHIE, Junction City, Kan. In perfecting this improvement the inventor supplies a mechanism for stamping and marking in general, but particularly adapted for stamping linen or sheets of fabric or other material, these being interposed between a type-bearing wheel and an elastic pad secured upon the table.

SPEED-INDICATOR.—C. E. KELLY, Anderson, Ind. Two patents have been granted Mr. Kelly for improvements in speed indicators. One invention provides an indicator which may be conveniently applied to indicate the speed or movement of any machinery, such as the speed of a wheel in traveling over the ground.

The other invention relates more particularly to a centrifugally controlled means for transmitting movement to a speed indicator. The device comprises a casing in the form of a hub which may be fitted to any rotary part. Within this casing a number of spherical weights coacting with inclined planes serve, when actuated by centrifugal force, to transmit the movements to a ring outside of the casing.

MAIL-CATCHER ARM.—F. M. EDWARDS, New York, N. Y. When the arm of this device is not required it can be locked at the center of its supporting-bar within the plane of the outer surface of the door-joint, and the arm may be reversed to bring its receiving end facing the direction of travel of the train and then brought to a receiving position beyond the door-jamb and locked at either end of its supporting bar. An automatic locking device is provided which offers no hindrance to the reception of a bag on the arm, but which acts to prevent the bag leaving until purposely removed.

MAIL-DELIVERER.—F. M. EDWARDS, New York, N. Y. This mail-deliverer is capable of ready attachment to the door-jamb of any mail-car and will not interfere with the use of the door. It is so made that a mail-bag may be quickly attached thereto at the top and bottom of the bag, the fastening device in no way stopping the safe and quick removal of the bag from the deliverer. The deliverer is held parallel with the side of the car within the doorway or extends out from the doorway at right angles to the side of the car. A crane is used with the deliverer, and it has supporting-arms for the bag like those of the deliverer.

MACHINE FOR CUTTING ARTICLES FROM THE INSIDE OF SHOES.—W. S. FULTZ, New Orleans, La. In operating this device, the shoe is turned bottom upward and slipped over the cutting mechanism. The workman works the shoe around over the neck, so that the cutters come in contact with the nails or tacks, cutting them out completely. By manipulating the shoe the cutters can be forced into the remote parts of the toe. The hand need not enter the shoe while the cutters work. The neck protects the gearing and the shoe.

COKE-DRAWER.—W. S. JONES and J. P. DONOHOE, Greensburg, Penn. The invention comprehends a carriage held to travel in front of the coke-oven and includes a platform, for sustaining the operator, reciprocal in the longitudinal plane of the oven. The carriage has a nose adapted to penetrate through the oven-door, with means for attaching the scraper and holding it in a position under the operator's control. Thus the scraper can be set in the coke at desired points and be pulled by the outer movement of the platform to draw the heavy coke bunches out through the oven-door. An endless conveyer receives the coke and conveys it to any suitable receiver.

Railway Improvements.

RAIL-JOINT.—F. S. PASCOE, Allegheny, Penn. Mr. Pascoe's invention refers to rail-joints and it provides a simple construction whereby the joint may be securely locked when applied and the locking key retained in position by the locking device.

AUTOMATIC TRIP-BRAKE.—E. L. CRIDGE, Passaic, N. J. In the design of this improvement on automatic trip-brakes for railway vehicles, the object is to stop such vehicles automatically in case the engineer for any reason disregards the danger-signal. The invention thus affords an efficient device for preventing railway collisions.

CAR-FENDER.—J. ROCLANDT, New York, N. Y. The object in this invention is to provide a fender that will be quickly lowered when a part comes in contact with a person or other obstruction, and thus prevent the car from running over the same. Means are furnished whereby the motorman may raise the fender to its normal position.

TRACK ATTACHMENT.—W. H. CROSSLEY, Bloomsburg, Penn. Mr. Crossley has invented an improved attachment designed to prevent fire hose run across the tracks of a street railway from being injured by the car wheels and at the same time obviate the interruption of travel. The attachment consists of a bridge which can be easily applied to a track to lead over the fire hose.

Miscellaneous.

CARBURETER.—A. H. RIFE and J. R. CARPER, Dallas City, Ill. This carbureter belongs more particularly to the type used in so-called "vapor-stoves," which burn gasoline and similar hydrocarbons. Four distinct vaporizing operations of the gasoline are effected. First, by contact with the heated plate; second, through close contact with the heated gauze; third, by a wick arrangement vaporizing by capillary attraction; fourth, where vaporization is due to a cup located immediately adjacent to an auxiliary flame and which receives any liquid remaining after previous vaporization.

APPARATUS FOR FORMING BLAST-FURNACE CHARGES.—A. S. DWIGHT, New York, N. Y. Provision is made in this apparatus for forming blast-furnace charges in a very simple manner, the arrangement being such that the charges prepared are of a certain composition and of approximately equal weight and the ingredients thoroughly mixed. Thus much saving of time and labor is effected.

LOOSE-LEAF LEDGER.—F. B. TOWNE, Holyoke, Mass. This is an improvement on a patent previously issued to Mr. Towne. The ledger or book is doubly locked owing to means for confining the leaves, few or many, securely in place and to the use of locking devices which hold the covers and back rigidly together, while the covers may open freely and the back lie flat on a desk. A stay bar connects the post against spreading under the leaves. Means are provided for obtaining access to the locking-slat and leaves on the post and also for enabling the leaves to be put in or withdrawn easily without tearing.

INDICATOR FOR TOILET-ROOMS.—E. D. ALLEN and W. A. MCELNEY, Meriden, Conn. This device is easily applied to existing structures. It is so arranged that it will automatically indicate whether a toilet room is occupied or vacant. It is adapted especially for railway-cars, and advantageously for rooms of hotels, houses and other places. It may be applied to a sidewall of a toilet-room or to the door and used on doors swinging in or out and also in connection with full or with half doors. The same effect may be had from the door bolt as from the floor.

HASP-FASTENER.—A. KELLER, Paris, Ill. This efficient device cannot be readily tampered with or unfastened. As the hinge is set down within the woodwork and has no pintle it offers no projections on which a chisel could be used. If a pintle were employed and the hinge projected, the pintle could be cut and removed, rendering the device useless. It is a superior fastener for boxes, trunks, car-doors, cell-doors, etc.

TRANSFERABLE JOB-BANK.—G. M. GREEN, O'Neill, Neb. This transferable job-bank consists of a flat slab provided with a rib at the lower end and a number of compartments sunk flush with the surface at the upper end. The bank is supported at an inclined position by angle braces. The many uses to which the device and particularly the compartments can be applied will be obvious to printers.

PURSING-SEINE.—W. F. HARRIS, Gloucester, Mass. With seines as heretofore used considerable difficulty has been experienced when circling around a shoal of fish by reason of the heavy metal rings attached to the foot of the seine which tend to drag the small fixed boat toward the fish, frightening them off before they are completely surrounded. This difficulty is obviated by the present invention.

CLIP-APPLIER.—G. J. VAN SCHOTT, Passaic, N. J. The efficiency of surgical appliances is advanced by this implement, which engages and presses a clip in position on a superficial flesh wound to close the same, the clip being preferably of the construction shown and described in a previous patent granted to Mr. Van Schott.

HAT-PIN AND FASTENER.—C. B. GARRISON, Cincinnati, Ohio. Means are here provided for mounting hat-pins in a hat so that the pins may be moved freely into and out of operative position without actually detaching them from the hat, while the devices employed permit the removal of the pin when desired. The formation of holes is avoided and the pin is firmly held.

NON-REFILLABLE BOTTLE.—P. J. ATZBERGER and F. W. PETERS, Cleveland, Ohio. The main purpose of the inventors is to furnish a bottle so constructed that after it has been emptied of its contents it cannot be refilled and again presented as an original package. They have provided one of this character conveniently made and substantially of the same shape as an ordinary bottle.

ANIMAL-TRAP.—V. WEILER, Lincoln, Neb. This structure is capable of trapping small animals, the size of rats and mice. It is a sensitive tripping mechanism. The slightest weight compels the quickness and certainty of operation, and the tripping part is so related to the bait-holder that the animal in its efforts to reach the bait must engage with the movable member, which springs the trap and drops the captive into the cage. The tripping devices form a runway and serve to close the subjacent cage, and they include automatic locking and setting parts.

CALENDAR.—A. F. HOFFMAN, New York, N. Y. The invention provides a simple and neat calendar which will indicate comparative dates for different years and their subdivisions. It comprises a board or base on which are secured twelve pads, one for each month. Each pad contains detachable leaves for the days of the month. Beneath these is a leaf containing the table for the entire month, while under this leaf is printed a table for the corresponding month of the previous year.

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Inquiry No. 3921.—For makers of small metal boxes, iron, brass or aluminium, in the line of match safes.

Blowers and exhausters. Exeter Machine Works, Exeter, N. H.

Inquiry No. 3922.—For makers of windmill pump cylinders in which plungers on pistons are used that work without leathers.

Handle & Spoke Mchy. Ober Mfg. Co., 10 Bell St., Chagrin Falls, O.

Inquiry No. 3923.—For a self-acting dividing engine for dividing 3 to 6 inch theodolites.

Dies, stampings and armature discs. Advance Manufacturing Co., Racine, Wis.

Inquiry No. 3924.—For wholesale dealers in mail order goods and rubber suitable for making rubber stamps.

Sawmill machinery and outfits manufactured by the Lane Mfg. Co., Box 13, Montpelier, Vt.

Inquiry No. 3925.—For the manufacturers of the Edison storage batteries.

FOR SALE.—60 h. p. Otto gas engine, the latest type, practically new. Colborne Mfg. Co., Chicago.

Inquiry No. 3926.—For manufacturers of brass numbering tacks for fly screens.

Let me sell your patent. I have buyers waiting. Charles A. Scott, Granite Building, Rochester, N. Y.

Inquiry No. 3927.—For manufacturers of sugar machinery and driers.

Machine Work of every description. Jobbing and repairing. The Garvin Machine Co., 149 Varick, cor. Spring Sts., N. Y.

Inquiry No. 3928.—For a 21-foot gasoline river launch fitted with good 2 to 4 h. p. engine.

Manufacturers of patent articles, dies, stamping tools, light machinery. Quadriga Manufacturing Company, 18 South Canal Street, Chicago.

Inquiry No. 3929.—For makers of suspender buckles, etc.

The best book for electricians and beginners in electricity is "Experimental Science," by Geo. M. Hopkins. By mail, $5. Munn & Co., publishers, 361 Broadway, N.Y.

Inquiry No. 3930.—For makers of pyrometers for bake ovens.

The largest manufacturer in the world of merry-go-rounds, shooting galleries and hand organs. For prices and terms write to C. W. Parker, Abilene, Kan.

Inquiry No. 3931.—For makers of sheet metal spinning and polishing lathes, also makers of novelties such as can-openers, cork screws, etc.

The celebrated "Hornsby-Akroyd" Patent Safety Oil Engine is built by the De La Vergne Refrigerating Machine Company. Foot of East 138th Street, New York.

Inquiry No. 3932.—For information about a crematory for disposing of refuse and garbage of a large town.

FOR SALE.—United States patent right of feed trough for poultry or swine. Price moderate. Copy of patent free. Jno. Ahrends,
Sunman, Ind.

Inquiry No. 3933.—For a strong horseshoe permanent magnet capable of lifting 15 or 20 times its own weight.

Wanted—Revolutionary Documents, Autograph Letters, Journals, Prints, Washington Portraits, Early American Illustrated Magazines, Early Patents signed by Presidents of the United States. Valentine's Manuals of the early 40's. Correspondence solicited. Address C. A. M., Box 775, New York.

Inquiry No. 3934.—For manufacturers or business concerns that will have an exhibit at the St. Louis Exhibition.

Patent No. 701,951 for sale or royalty. The strongest and most rigid adjustable alligator wrench invented.
Wm. Shirk, Panama, Iowa.

Inquiry No. 3935.—For parties to make odd-shaped bottles reasonably.

FOR SALE. Thornycroft steam wagon, good condition, 23 h. p., speed 8 miles, capacity 5 tons. Address W. L. M., 82 Cotton Exchange Building, N. Y. City.

Inquiry No. 3936.—For machines for embossing leather and fiber chair seats.

Inquiry No. 3937.—For parties handling the Edison "Loud Speaking Telephone" and the Hewitt mercurial vapor lamps.

Inquiry No. 3938.—For automatic weighing machines for sacking and weighing grain.

Inquiry No. 3939.—For makers of electric blue print machines.

Inquiry No. 3940.—For makers of electro-magnets with disk armatures for use in pipe organ actions.

Inquiry No. 3941.—For makers of electric clocks for hotels, schools and factories

Inquiry No. 3942.—For a machine for winding fine wire.

Inquiry No. 3943.—For a steel hull 30 feet long, flat bottom, to draw not over 10 inches loaded, propelled by stern wheel driven by gasoline engines.

Inquiry No. 3944.—For makers of kerosene oil pressure lamps on the Kitson principle.

Inquiry No. 3945.—For makers of wooden novelties, such as spoons, forks, bowls, plates, etc.

Inquiry No. 3946.—For makers of polished hardwood bases suitable for telegraph instruments.

Inquiry No. 3947.—For information as to machines for making pyroligneous acid.

Inquiry No. 3948.—For makers of hard rubber goods, such as telephone receivers, hard rubber tubing, etc.

Inquiry No. 3949.—For a second-hand gasoline engine between 3 and 5 h. p.

Inquiry No. 3950.—For address of parties making small gas engine castings with drawings.

Inquiry No. 3951.—For castings and connections for a small electric motor.

Inquiry No. 3952.—For a machine for manufacturing wooden oars

Inquiry No. 3953.—For the manufacturer of the collapsible lifeboat which was recently tested at the Brooklyn Navy Yard.

Inquiry No. 3954.—For crude rubber and asphaltum used in the manufacture of roofing paints.

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Notes and Queries.

HINTS TO CORRESPONDENTS.

Names and Address must accompany all letters or no attention will be paid thereto. This is for our information and not for publication.

References to former articles or answers should give date of paper and page or number of question.

Inquiries not answered in reasonable time should be repeated; correspondents will bear in mind that some answers require not a little research, and, though we endeavor to reply to all either by letter or in this department, each must take his turn.

Buyers wishing to purchase any article not advertised in our columns will be furnished with addresses of houses manufacturing or carrying the same.

Special Written Information on matters of personal rather than general interest cannot be expected without remuneration.

Scientific American Supplements referred to may be had at the office. Price 10 cents each.

Books referred to promptly supplied on receipt of price.

Minerals sent for examination should be distinctly marked or labeled.

(8877) A. J. R. writes: I have a small machine requiring about ¼ horse power to operate, and which we run continuously, and am desirous of getting some economical power to operate and run it, and write to ask if there is anything on the market more economical and satisfactory than the gasoline engine, and would it be possible to so arrange gears as to run the machine by clockwork, or weight or spring? A. There is no power in a small way so good or so cheap to run as a gasoline motor. You should have for your work one of a half horse power. Weights or springs have to be wound up, and only give out power for a very short time, and not all that is put into them in winding. They have been tried for useful work, and have been given up as only suitable for clocks, small fans, and for turning images and goods in show windows.

(8878) H. H. asks: Will you please tell me how much air compressed to 100 pounds pressure will expand when released? The quantity of air released to reduce pressure one pound. A. The air released from 100 pounds pressure will expand 4¼ times its volume. The quantity released to reduce the pressure one pound must be 0.068 of the volume of the air holder.

(8879) W. V. H. writes: Inclosed you will find drawing describing at the bottom what it will do. Please explain why the motor reverses when wire is connected at A. A. When one cell is used in your Porter motor as shown in your diagram, the motor runs as a series motor. When you connect the second cell, the armature or the field, as you may look at it, is reversed, and the direction of the rotation of the armature is reversed. To reverse the current in both field and armature does not reverse a motor; to reverse one of these alone does reverse the motor.

(8880) F. A. H. writes: I am producing, in an induction coil, alternate currents in the secondary by employing, instead of the usual contact breaker, the change from highest to lowest resistance in the primary, just as is done in the telephone with the transmitter in series with the primary of the coil. I learned from you some time since that these secondary currents could be made pulsating direct by the use of a condenser. This has been argued against by others whom I have since been in connection with. Will you kindly advise me just how to accomplish the desired results, either with the contact breaker or, for instance, the transmitter, should it be possible? A. With a condenser attached to an induction coil, the spark at the break of the circuit in the vibrator is made much longer than the spark at the making of the circuit through the primary. Hence if the spark terminals are drawn apart so far that no spark passes on the closing of the primary circuit, only the spark at the break can pass, and that will always be in one direction. The secondary current becomes a pulsatory unidirectional current. When the spark terminals are near enough to each other, the secondary current passes both at the make and at the break of the primary circuit, and an alternating pulsatory current is produced in the secondary winding.

(8881) C. D. S. writes: We have a pancake griddle using charcoal which is not a success. I would like to convert it into an electrical one. The size is 2 feet 5 inches by 1 foot 3¾ inches. How much and size of steel wire would be required to raise it to the right heat at 110 volts pressure? A. We do not advise you to attempt the winding of an electrical griddle. The danger of fire is too great. Special asbestos insulation is required by the underwriters for such articles, and you would find it far cheaper in the end to purchase an article made to conform to the requirements of the insurance companies. We do not know the temperature of a griddle nor do we know the allowance to be made for radiation in such a large surface exposed to the air. Much practical experience in designing cooking utensils is needed to answer your question. You will probably need to use from 5 amperes to 15 amperes at the various heats. You would then require 22 ohms of wire so arranged as to be cut out by a switch to 7 1-3 ohms. You can obtain griddles of all sizes from the American Electric Heating Corporation, 1137 Monadnock Block, Chicago, Ill.

(8882) O. F. asks: Will two coils of insulated copper wire attract one another when an electrical current is passed through them in the proper directions? What is the maximum of attraction obtainable expressed relatively to the weight of the coils? A. A coil of wire carrying a direct electric current is an electromagnet, and two such coils will attract each other as two electromagnets will do. The attraction depends upon distance, mode of winding, amount of iron on the cores, etc. To determine the attraction of the coils you would use you should make and try them. You cannot use the alternating current in an electromagnet.

(8883) A. G. P. asks: For a magnet with cores 1¼ x 5-16 inch what size wire should I use to get the strongest magnetism when wound the multiple-wire method? Will a magnet wound this way be as strong as one wound the regular way? About what is number of pounds pull on the tailpiece of a guitar when the instrument is in tune? A. There is no need to wind a small bar of iron by a multiple wire to obtain its magnetic saturation. Use any convenient number of wire from 20 to 24 and wind the spool to a depth of ¼ to 1-3 inch. Then two to four cells of battery will make it lift its full load. The theoretical lifting power would be 15 pounds which it is not probable you can reach. We are not able to give the pull upon the tailpiece of a guitar. If you have a spring balance, you can easily measure it by taking each string separately and tuning it to its note with one end attached to the hook of the balance. Get the strain in pounds for each string, and add the separate pulls together. You can do the same thing by using weights or stones instead of a balance and weighing them. The exercise of your ingenuity will enable you to do your own investigating, and be of more benefit to you than if we could tell you directly.

(8884) I. C. R. asks: What will make silk waterproof and stiff at the same time? A. After the silk has been soaked in glue and dried, it should be digested for several hours in a solution of alum; this will make the glue insoluble, and therefore waterproof. Or the glue may be rendered insoluble by digesting the treated silk in a weak solution of formaldehyde. Casein can be used in place of the glue; after drying the treated silk, the casein can also be rendered insoluble by formaldehyde.

(8885) H. K. asks: How can I connect 12 3½-volt lamps, consuming between 50 and 60 amperes each, on a 108-volt alternating current? Lamps are a trifle over 1 candle power. A. You cannot connect 12 3½-volt lamps economically to a circuit with 108 volts in it. The twelve lamps have 42 volts in series. You can connect them in series to a resistance, or inductance coil, and thus light them. You should apply to the company furnishing the current for the connection, and they will fit you out with the proper apparatus. Such low-voltage lamps are made for battery use, and ought not to be put on a high-voltage circuit.

(8886) D. H. F. asks: What percentage of shrinkage is there in the casting of brass? That is, how much larger should the pattern be to give the proper dimensions? A. The shrinkage allowance on patterns for casting brass should be 3-16 of an inch per foot in length or diameter.

(8887) F. S. P. asks: Can you furnish me with a recipe giving full directions for making Flemish oak finish? A. The wood is smoothly surfaced, and a solution of copperas containing one ounce in two quarts of water is brushed over. Follow this with an oil stain mixed with sienna or umber and drop black to color desired. Finish by waxing the wood one or more coats to get the desired effect, leaving the grain rubbed off smooth and open.

(8888) C. J. S. asks: Can you tell me how to make an electro-magnet to be used on 100-volt alternating current? A. An electromagnet cannot be used upon an alternating current. They are employed with a direct current. The alternating current flows first in one direction and then in the opposite direction through the circuit, so that the poles of the magnet are reversed at each alternation. Such an arrangement is not serviceable.

(8889) S. G. asks: What is used in the mantle of the Welsbach which gives to it its brilliancy, and in what manner is it applied; and also what change or action is it, chemically or physically, that causes the mantle to glow so brilliantly? A. The Welsbach mantle is made in the following manner: A net is woven out of thread, and this is then thoroughly impregnated with a solution of the mixed nitrates of thorium and cerium, in the proportions of 99 per cent of the former to 1 per cent of the latter. It is put on the market in this shape. Now, when a match is touched to it, the thread burns away, and the nitrates are decomposed to the respective oxides, and there remains therefore a coherent web of these oxides having just the shape and structure of the original net. Primarily, the luminosity is caused by the high temperature, just as is the case with the ordinary lime light, the heat rays of the flame being raised to light rays. Just why a mixture of thoria and ceria, containing one per cent of the latter, gives the maximum intensity of illumination, has not been definitely proven, though various theories have been advanced. Measurements with a thermo-element show that in the same zone of the Bunsen flame, this mixture will attain a higher temperature than either thoria or ceria or any other earth, if alone; while this does not explain why it attains a higher temperature, it does explain why there is greater luminosity.

(8890) D. McK. asks: How much does a bushel of vermilion red weigh? How much does a bushel of yellow ocher weigh? What is the specific gravity of red lead? What is the specific gravity of white lead? Do vermilion red and red ocher mean the same thing? A. Ocher is very variable in character and weight: a Winchester bushel will weigh from 125 pounds to 170 pounds. As Venetian red is also equally variable, its weight will also vary, but runs somewhat higher than ocher. The specific gravity of red lead is about 9; of white lead, about 6.5. Venetian red is made by burning ocher; the term red ocher is rather unusual, but it would probably be the same as Venetian red.

(8891) C. T. J. asks: 1. What is the equivalent of one H. P. in man power: i. e., about how much man power equals one H. P.? A. For constant work a horse power is equal to the work of 8 men. 2. What is the reason that two *platinum* strips are always placed in the acidulated water to be decomposed by an electric current? Why couldn't two strips of any other metal that is a conductor of electricity be used? A. Platinum is employed as electrodes in decomposing water because it is not attacked chemically by either the oxygen or hydrogen of the water when they appear upon it as nascent gases. It is the cheapest metal, if not the only one, of which this is true. Hydrogen can be collected by the use of carbon electrodes; but the oxygen combines with the carbon to form carbon dioxide, which can be collected if desired. Oxygen cannot be collected from carbon. 3. Could a small electric motor, say ¼ or ½ H. P., to be run on a 110-volt, 5½ or 6 ampere, alternating current, incandescent lighting circuit, be started and stopped by means of a switch only, or would a rheostat also be necessary as with the larger sized motors on circuits of higher voltages? A. A small electric motor is usually provided with the proper coils for starting and running at two or three speeds in the machine itself. The switch then has three or four points, and is fastened to the frame of the motor. It is more convenient to place these in a separate place in a large motor. 4. Would you please state the difference between the induction coil used in connection with the X-rays and telephony, and the inductance coil used in wireless telegraphy? A. An induction coil has two windings, the primary and the secondary. A current in the primary induces another current in the secondary, of a different voltage and current strength in amperes. Such are Ruhmkorff coils and transformers generally. An inductance coil has a single winding, usually without iron, to act as a restraint upon the rush of the current through the circuit. This it does by the counter electromotive force produced in the coil by its self-induction. Its effect is produced not merely by its resistance in ohms, but also by the impedance due to the reactance of the turns of the coil upon the current. 5. About what would be the voltage and the amperage of a Wimshurst frictional electric machine having its two circular discs of glass 16 inches in diameter (each), the glass being 1-16 inch thick? (Machine gives a spark 1½ to 2 inches long.) A. The voltage corresponding to a given length of spark cannot be stated in exact figures. It depends upon a number of factors: whether plates or balls are employed as terminals, and their size in each case; also upon both temperature and pressure of the atmosphere. A good discussion of this is to be found in Thompson's "Elementary Lessons." About 28,000 volts are usually given as the pressure needed to force a spark through one inch of dry air. 6. About what would be the voltage and the amperage of a No. 4 Laclede sal ammoniac cell? What would it be, and how is it calculated, for a battery of three such cells in series, in multiple? A. The Laclede cell has about 1.4 volts on open circuit, as do all the various forms of sal ammoniac cells. On closed circuit it quickly falls to 1 volt or less, if the current is as great as two-tenths of an ampere. Upon opening the circuit they recover quite well, since they have so large an area of carbon. Three cells in series will have three times the voltage of one; in multiple they will have the same voltage as one cell. The amperes cannot be given since they depend upon the resistance of the external, as well as upon the internal resistance of the cells. 7. I have read that some damage might be done to a storage battery by overcharging, but that there is always more or less damage done by over-discharging. Could you please explain how this (over-discharging) damages the battery, and is there any way in which to prevent it by simply observing the lead plates or the sulphuric acid and water in which the plates are immersed, in a simple home-made cell not equipped with measuring instruments? A. Over-discharging injures a storage battery by converting too much of the active material. It reduces a battery to too feeble a condition. It may even be carried so far that it is scarcely possible to charge the cell properly again. See Treadwell's "Storage Battery" for more instruction upon these matters. No storage battery should be run for work without having the proper instruments for indicating its condition.

(8892) G. J. V. asks what are the ingredients used in the manufacture of lava insulators; also enamel on the backs of resistance plates. A. The enamels used on insulators are the same as are used on dishes. There are many formulas. A good one is: Take quartz, 100 pounds, calcined and ground; borax glass, ground, 50 pounds. Mix, fuse in a crucible, and let cool slowly. Powder 40 pounds of this glass, and mix with 5 pounds of white potter's clay. Grind the mixture to a fine paste in water. Apply to a clean surface, and let it stand in a warm dry place to dry. After this, it is burned in an oven. A glaze can be put upon this by using a powder of white glass 125 pounds, borax 25 pounds, carbonate of soda, fused and powdered, moistened and dried, 20 pounds. To 45 pounds of this add 1 pound soda. Mix thoroughly and dry. Then reduce to a fine powder. Dust the surface of the enamel while still moist with this powder, and then bake. Several coatings of the glaze may be put on, one after another. The lavas are made of fine clays baked as porcelain is treated. For many receipts for doing this see "Cyclopedia of Receipts."

(8893) O. C. S. writes: A friend of mine claims that the wheels of a railroad car slip sideways only when rounding a curve. I claim that they also have what I shall call, for want of a better expression, a rotary slip; that on a slow-moving train the outer wheels slip, while on a faster train the inside wheels slip. What are the facts in the case. A. The wheel flanges of railway cars bear against the outer rail when rounding a curve by their momentum, and against the inner rail when strongly pulled by the locomotive. The inner and outer wheels both slip, the inner one forward and the outer one backward, according to the conditions of running on a curve. The centrifugal force at high speed throws the greater weight on the outer wheels, when the inner wheels slip forward.

(8894) C. E. H. asks: If we take a Bunsen burner using good fuel gas, capable of 700 heat units per cubic foot, and burn this with a naked flame, the heat resulting from each cubic foot of gas consumed would be diffused into the surrounding atmosphere, and would raise the temperature as high as 800 units. Now, if we take the same burner and surround it with a sheet metal tube after the manner of an ordinary gas radiator, and in addition to the tube place two or three metal deflector plates at a convenient distance above the flame, so as to have as much radiating surface as possible, we find under these conditions the temperature of the surrounding atmosphere is raised very much higher than it would with the naked flame, although we are using the same burner and producing approximately the same number of heat units per cubic foot of gas. How do you explain this increased efficiency for heating? A. Your difficulty with the difference in the heating power of gas when burned with an open flame or with a radiator is easy of explanation. When the open flame is used, the heat is carried up to the ceiling in a strong current of air, and the upper part of the room is much hotter than the lower part. The heat is lost, since we do not live up there. A radiator does just what its name implies—stops the rising of the heat. The heat of the flame is communicated to the metal of the radiator, and this acts as the real heater. It sends out the heat, down and all around with equal facility. You can test this with a thermometer, and see how the air below the radiator is heated. With the open flame the space below the flame is cold, by reason of the draft of cold air drawn in to feed the flame. Radiant heat travels down as easily as it rises. Convection currents of air always rise, and carry the heat up with them.

(8895) G. H. B. says: I have just commenced to nickel-plate, and am plating for a large stove firm; they have all one can do. I have turned out some fine work, but some of the nickel will peel off. As I am a beginner, I have used nickel salts and single salts for the exposed parts. I was told to plate the pieces in nitrate of copper first, to make the nickel adhere better. I tried it, but did not get any copper plate on. Please tell me the best way to get the best results of platings. A. The peeling off from some of the work is probably due either to imperfect cleaning of the object or by using too strong a current. The failure with the copper was due to the use of the nitrate of copper, with which it is practically impossible to do any plating. Copper sulphate, copper acetate, or copper carbonate, together with sufficient potassium cyanide to make the double salt, is the proper material to use. See "SCIENTIFIC AMERICAN Cyclopedia of Receipts," article on "Electro-metallurgy."

(8896) H. M. H. asks if hard woods can be used in the manufacture of wood pulp. How fine wood is ground for the pulp? To what process is the wood submitted after being ground, and in what shape is the pulp put for the market? A. Hard woods are not used; spruce and the other pines give the best pulp; linden and aspen give a whiter pulp, but of inferior quality. After grinding, the mass is beaten to complete the disintegration and hard woody masses are separated. The pulp is then collected in endless screens and pressed between rolls.

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(8897) A. F. S. asks: Does not liquid oxygen as produced by liquid air become opaque to magnetism, that is, is it slightly attracted by a magnet? A. Oxygen was discovered to be a magnetic substance by Faraday in 1849, by noting that it was attracted to a magnet pole just as iron is, though to a lesser degree. Becquerel was the first to call attention to the subject in recent times. In 1892 Dewar, having produced liquid oxygen in large quantity, renewed the matter and showed that liquid oxygen has about one-thousandth of the magnetic moment of iron. Liquid oxygen is shown in a tube swinging to the pole of a magnet, in Sloane's "Liquid Air," page 337, but the language used in the text describing the experiment is not correct. It should read: "Oxygen was discovered to be *magnetic* by Faraday." The fact is just the opposite of the statement of the book.

(8898) R. R. J. asks what voltage is required to jump a spark gap of ¼ inch, and if the voltage is in direct proportion to the width of spark gap. Also, how to determine the number of oscillations and wave length wireless telegraph system as mentioned in SUPPLEMENT, No. 1383, Siemens & Halske system or any system. A. The voltage necessary to force a spark through ¼ inch of air varies greatly with the shape of the terminals, as points, balls or plates; and with the pressure, moisture, and temperature of the air. Thus a spark 1-5 inch long was produced between balls 1-10 inch in diameter by 16,200 volts; and between balls 1 inch in diameter by 18,900 volts pressure. The subject is quite fully treated in Thompson's "Elementary Lessons." The methods of measuring lengths of electrical waves will be found in papers given before the American Institute of Electrical Engineers. Prof. Pupin has presented several papers upon these topics, which we cannot abstract in a letter.

(8899) S. M. G. inquires whether a jump spark coil can be made by single windings instead of primary and secondary windings. If so, what size wire and how heavy insulation is best for a current of 5 to 8 volts pressure? A. A coil can be made for gas lighting and similar small uses with one winding; but a jump spark of sufficient length to make a sure ignition in a gas engine should be an induction coil with primary and secondary windings. A spark coil with one winding may be made with a core 10 inches long, covered with paper. The winding should be of cotton-covered magnet wire, say No. 14, of which 300 feet or thereabout may be wound on. The spark is given at the breaking of the circuit, and is due to self-induction. Each layer may be separated from the adjacent layers by brown paper, not very thick. No very definite rules are required, as there is a great difference to be noted among these coils. The battery may vary, and as it runs down, more cells may be attached.

(8900) A. B. C. asks for a formula for oxidizing linseed oil without litharge; want to have oil very heavy and bright, and entirely free from fat. A. Keep the oil at a temperature of somewhat over 130 deg. C., while a current of air is passed through or over it; then increase the temperature until the oil begins to effervesce from evolution of products of combustion. By continued boiling the oil becomes very thick and may be drawn out into elastic threads, which are very sticky, but do not produce a greasy stain in paper.

(8901) R. F. D. asks: In the Planté type of cell, how many square inches of positive plate surface are reckoned for one ampere-hour? By Planté type I understand that metallic leaden plates are immersed in the electrolyte, which I suppose is correct. A. The Planté type of secondary cell is defined by Foster in his "Electrical Pocket Book" to be "constructed of lead plates so designed as to present a large surface area to the action of the electrolyte, the active material being formed on the plates, either electrically by charging and discharging, commonly called forming, or chemically." The same authority gives a formula for calculating the theoretical capacity of a cell per pound of active material. This is the better way of expressing it, since to base the capacity upon the surface will not take the thickness into account. The *practical* results given are: For lead peroxide and the same weight of spongy lead per ampere hour: 0.53 ounce for a ten-hour rate of discharge; 0.62 ounce for a five-hour rate of discharge; 0.70 ounce for a three-hour rate of discharge; 1.00 ounce for a one-hour rate of discharge. These numbers are for plates of ordinary thickness and an electrolyte of the density of 1.200.

(8902) P. S. B. wants to know the composition and the method of manufacture, of carborundum. A. The mixture from which carborundum is produced consists primarily of coke and sand, to which is added a small amount of salt to facilitate fusion, and a small amount of sawdust, which evolves gases upon heating, and these gases tend to keep the mass more porous and thus facilitate the escape of the carbon monoxide gases later produced. This mixture is packed between the two carbon poles carrying the current, there being, however, a central core of coke placed directly between the carbon poles, providing thus a conductor for the current and so overcoming the difficulty of starting up, and also keeping the internal resistance more uniform by breaking up the arc into numerous small arcs. Carborundum is a silicide of carbon; the formula is CSi.

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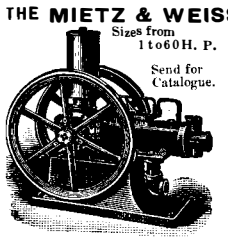

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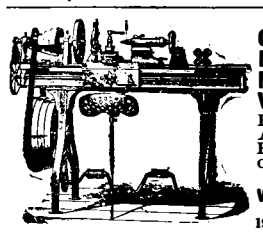

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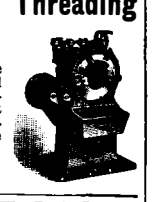

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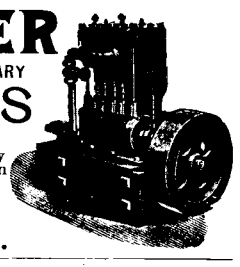

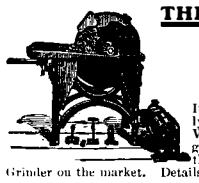

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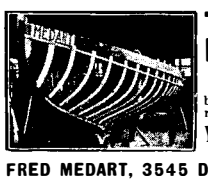

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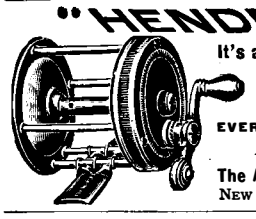

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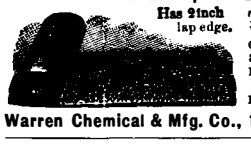

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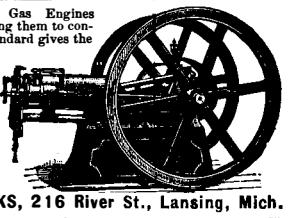

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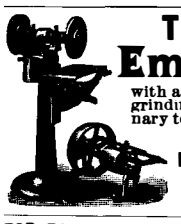

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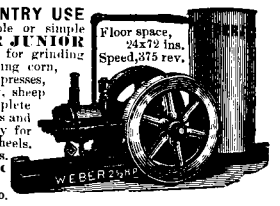

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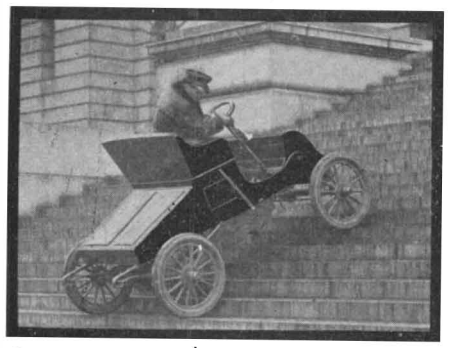

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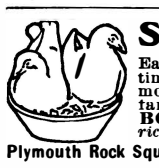

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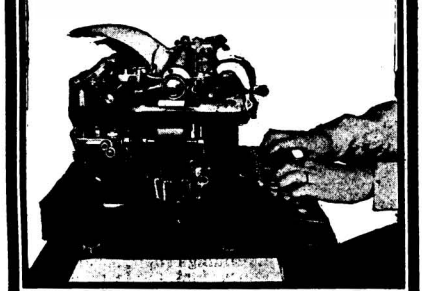

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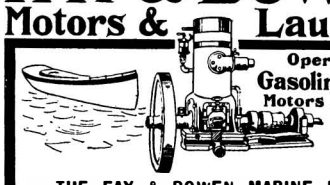

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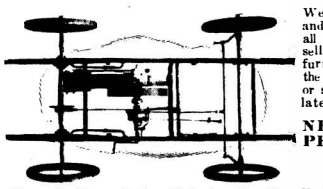

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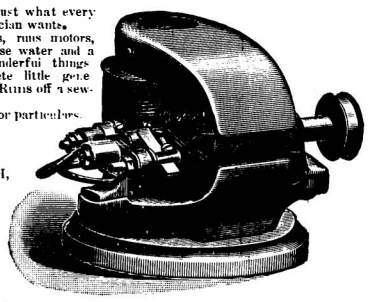

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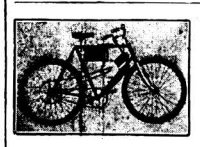

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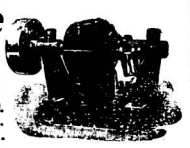

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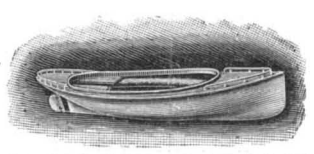

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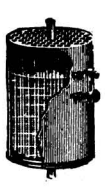

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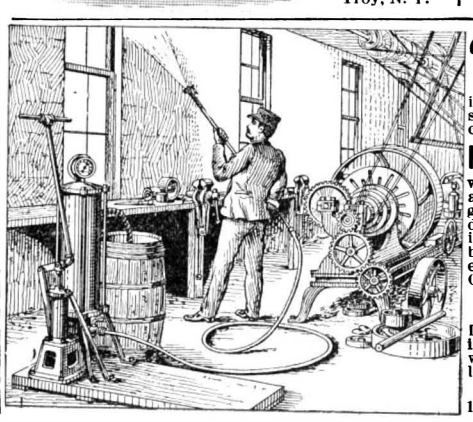

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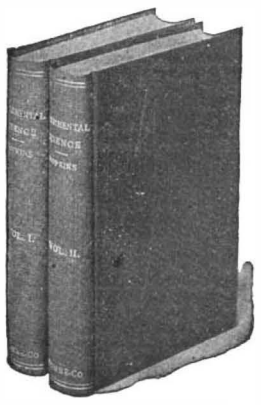

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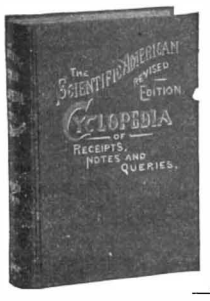

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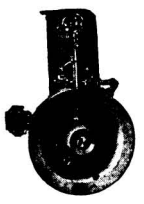

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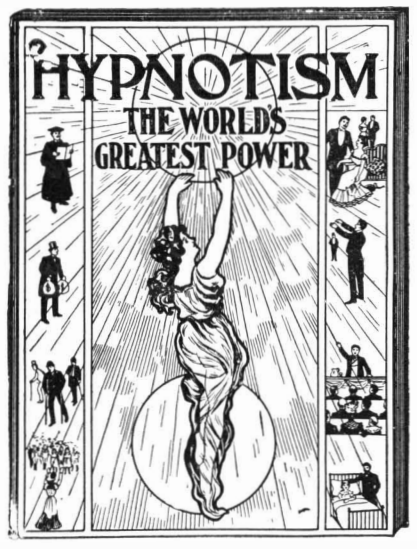

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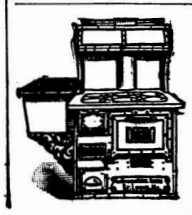

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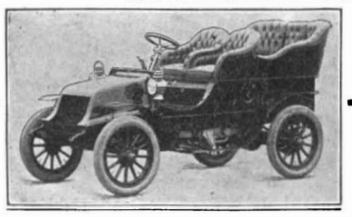

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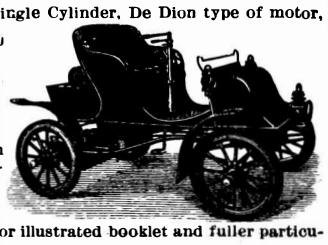

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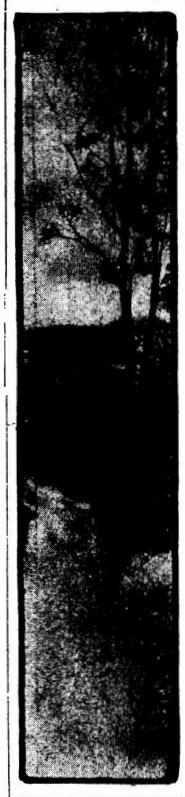

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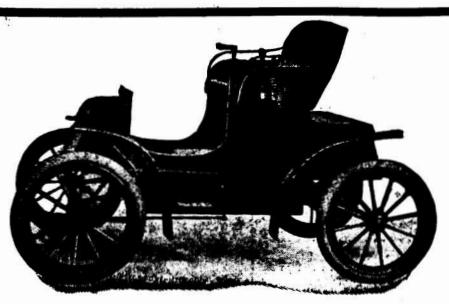

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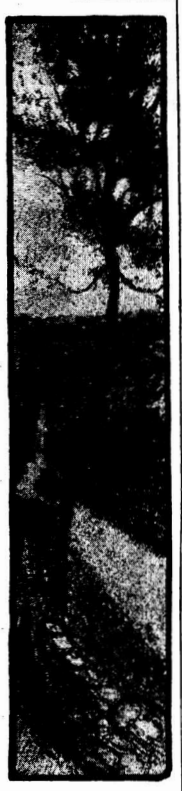

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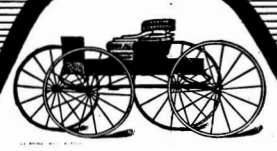

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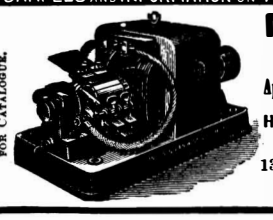

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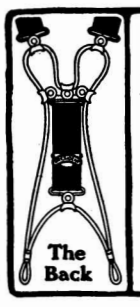

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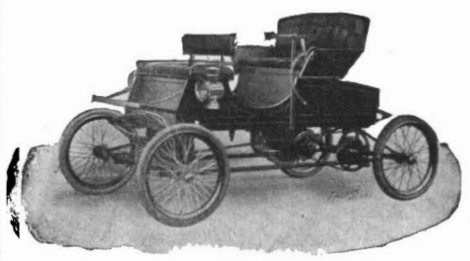

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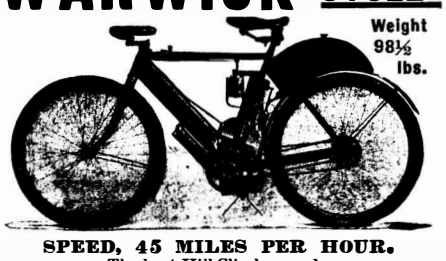

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